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ELECTRONIC COMPUTER PROGRAMMING INSTITUTE

I·B·M Data Processing and Computer Programming Course

STUDY UNIT VI

LESSON 16 - 17 - 18 - 19 - 20

I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING

LESSON #16

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16.1 DIGIT SELECTION

IBM machines distinguish between types of cards by the presence or absence of control punches. The most common control punch used in the IBM system is the "x" punch. We have had several problems (in the Interpreter, Reproducer and 402 Accounting Machine) where the operation of the machine has been determined by an "x" control punch.

In this lesson we are going to study problems which involve the use of digits as control punches. In other words, specific digits, rather than "x" punches will be used to identify our cards.

We have a device in the 402 which permits us to "split" the reading of the impulses from a column into 12 separate impulses (each corresponding to a zone in the card.) If you recall our discussion of the "column split", you will remember that this device splits a card into two segments (12-11 & 0-9). Extending this theory one step further, you will see that we can split the card into twelve segments. The device used to do this is called a "digit selector."

Digit selectors in the 402 are optional features. A machine may have either one or two digit selectors. They are located on the control panel at A-D, 45-57, immediately above the pilot selectors. See Figure 1.

The use of digit selectors will be described in the sample problem that follows.

SAMPLE PROBLEM:

We are to prepare a tabulated report as shown in Figure 2. The cards to be used are in the following format:

Field	Card Col.
Cust. No.	1-4 (Minor control group)
Type transaction	6 (Sales cards have a digit 9 in this column. Return cards are blank in this column.)
Amount	7-10.

Three counters are set up for this report: counter 6A will add all cards that contain a "9" in c.c. 6. - this is the sales counter; counter 8A will add only those cards which do not contain a "9" in c.c. 6 - this is the return counter; and counter 8B will add those cards with a "9" in c.c. 6 and subtract those cards that do not have a "9" in c.c. 6 - this is the net sales counter.

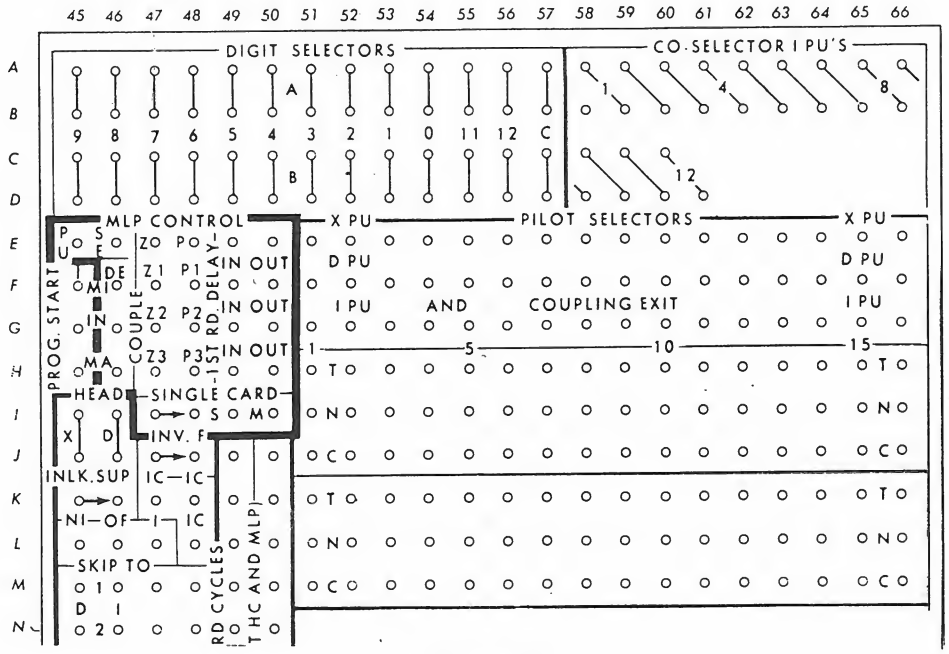

Figure 1.

Sales Analysis by Customer

Cust. No.	Sales	Returns	Net Sales
1234	6890	450	6440
1456	8320	10450	2130CR
2367	15000		15000
4560		2350	2350CR

Figure 2.

Figure 3 is the solution to this problem.

Notes on Figure 3:

A. Our indicative information (cust. no.) is wired to num. t.b. 1-4.

B. c.c. 1-4 are wired to our comparing magnets to set up program control.

C. Our amount field is wired to all three counters using the common counter entry hubs to get our information from one counter to another.

D. Counter exit suppression is wired as this is a tabulated report.

E. c.c. 6 is wired from second reading to the C hub of digit selector 1. Should a card contain a "9" in c.c. 6, this impulse will come out of the 9 hub of the digit selector. It is wired to the DPU hub of pilot selector 3 and will transfer that selector on the next card cycle. Should the card not contain a "9", nothing will come out of the 9 hub of the digit selector and the pilot selector will be normal for the next card cycle.

F. Card cycles is wired into the Common hub of the selector and from the transferred hub (for cards which have "9's" in c.c. 6) into counter 6A; it is wired from the normal hub into counter 8A. The other position of the selector is used to cause sales to add in counter 8B and returns to subtract.

G. All counters are cleared.

H. Should counter 8B contain a minus total, a CR symbol will be printed.

I. Negative balance test exit is wired to negative balance control and CI is wired to the C hub of counter 8B.

J. Our counters are wired to print totals.

Note here that the DPU hub of the selector will accept any impulse and transfer the selector on the next card cycle (when the card which contained the digit is at third reading.) Whatever punch is in a card will cause an impulse to come out of its correspondingly numbered hub of the digit selector.

EXERCISE 1.

Prepare the control panel diagram required to produce the report shown in Figure 4 (Earnings Register.) Fields and card columns are indicated below:

Field	Card Col.
Employee No.	18-21 (Minor control group)
Employee name	22-34
Card code	60 (the gross pay card has a "5" in this card column. All deduction cards are blank in this column.)
Amount field	62-66.

There are multiple cards for each employee. Gross pay is to be accumulated in counter 6A; deductions are to be accumulated in counter 8A; net pay (gross minus all deductions) is to be accumulated in counter 8B. Should net pay be minus (this is unlikely)

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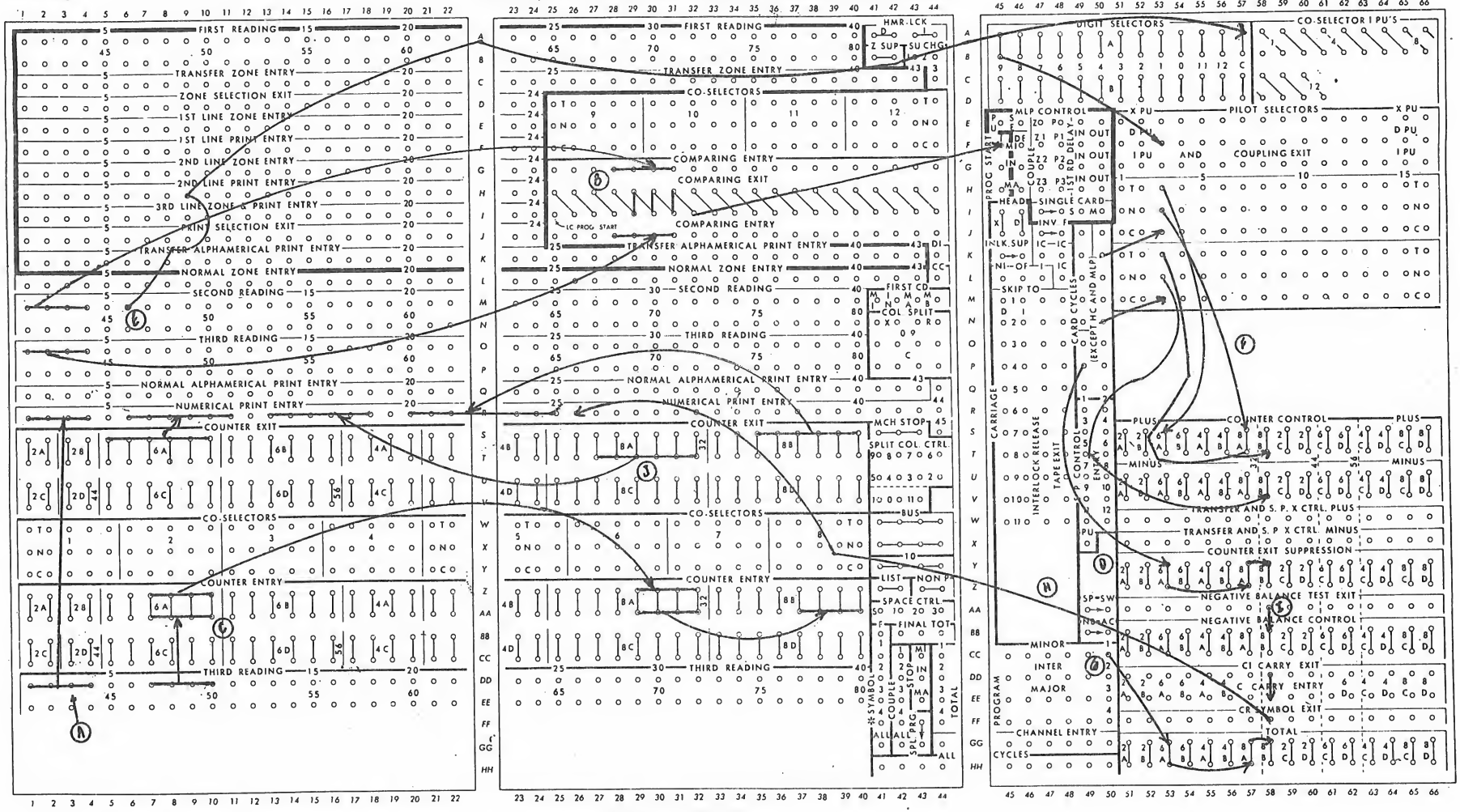
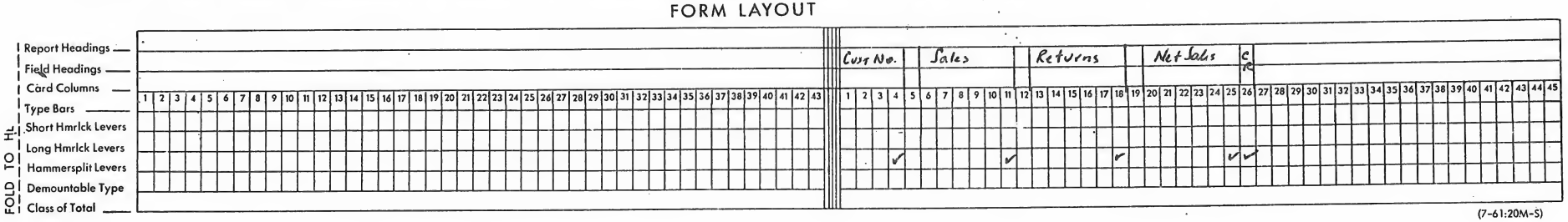


Figure 3.

FORM LAYOUT



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print a CR symbol in numeric t.b. 18. All other typebars to be used are shown in Figure 4. The solution to this problem will be found in the back of the lesson.

16.2 MULTIPLE X AND MULTIPLE DIGIT SELECTION

In the problems discussed to date, we have discussed the means whereby we can distinguish between types of cards. We know that we do this by means of control punches in certain cards - and we know that these control punches can be either "x" punches or digits. We have, up to the present, limited ourselves to two types of cards in a problem. There are many types of jobs where we have more than two types of cards. We may have three, or four, or five, or any number. Each type would have a distinguishing control punch. In this type of problem, we would have multiple control punches. How they are used is the topic next to be discussed.

Let us take a typical inventory problem. Here, we are usually dealing with three types of cards: (1) an opening inventory card (the quantity we start with); (2) New receipts (what has entered inventory); (3) requisitions (what has been taken from inventory). In order to calculate a closing inventory, we add receipts to our opening inventory and then subtract requisitions. This can be illustrated in the form of a report as shown in Figure 5.

There are multiple cards for each item number - this is a tabulated report. There are three types of cards: (1) Opening inventory (has an X c.c. 36); (2) Receipts (have an X c.c. 40); (3) Requisitions (have an X c.c. 78). All the cards have been sorted into sequence by the item number field, c.c. 1-4. The quantity amount in all three types of cards is in c.c. 13-16.

EARNING REGISTER

EMPL. NO.	NAME	GROSS PAY	DEDUCTIONS	NET PAY
657	H. Radcliff	10000	1520	8480
876	L Brownell	6500	425	5575
1134	P Henderson	14500	2400	12100
	Typebars			
A 26-29	A 31-43	N 1-5	7-11	13-17

Figure 4.

Item No.	Opening Inventory x36	Receipts x40	Requisitions x78	Closing Inv.
1234	560	40	60	540
2354	1560	4500	3000	3060
4567	239		28	211
8879	187	300		487
	6A +x36	6B +x40	6C +x78	8A +x36 +x40 -x78

Figure 5.

Figure 6 is the required control panel diagram.

Notes on Figure 6:

The only part of this problem that deals with new principles is that part which concerns the use of multiple pilot selectors.

Three pilot selectors are used in this problem. Selector 1 will be transferred for all X36 cards (opening inventory); selector 5 will be transferred for all X40 cards (receipts); and selector 3 will be transferred for all X78 cards (requisitions). Note that at any time, in this problem, only one selector will be transferred and the other two will be normal.

At the time an X36 card is passing third reading, selector 1 is transferred. The card cycles impulse wired to the top common hub will come out of the top transferred hub to impulse counter 6A to add. The other card cycles impulse wired to the bottom common hub will come out of the bottom transferred hub to impulse counter 8A to add.

At the time an X78 card is passing third reading, selector 3 is transferred and selectors 1 and 5 are normal. The card cycles impulse which enters the top common hub of selector 1 will come out of the top normal hub of selector 1 and enter the top common hub of selector 3. Selector 3 is transferred so this card cycles impulse will come out of the top transferred hub of selector 3 to impulse counter 6C to add - and from the common "plus" hub of counter 6C, it impulses the subtract hub of counter 8A (the closing inventory counter.)

At the time an X40 card is passing third reading, selector 5 is transferred and selectors 1 and 3 are normal. Trace the path of both card cycles impulses as they enter the common hubs of selector 1. The top one comes out of the normal hub of selector 1 into the common hub of selector 3; then out of the normal hub of selector 3 into the common hub of selector 5; then out of the transferred hub of selector 5 to impulse counter 6B to add. The lower card cycles impulse comes out of the normal hub of selector 1 into the common hub of selector 5; and out of the transferred hub of selector 5 to impulse counter 8A to add.

Note that counter 8A receives two impulses to add, one from X36 cards and one from X40 cards. It also receives an impulse to subtract for X78 cards.

Selectors are used as switches to divert the path of an impulse. The control punch is read at second reading to transfer a selector at the time the card is passing third reading.

Let us examine a problem which uses multiple digits to distinguish various types of cards.

SAMPLE PROBLEM:

We are going to prepare a report called a Deduction Register (shown in Figure 7.) There are multiple cards for each employee. All the cards have been sorted into sequence first by Serial No., and then by Dept. The fields and card columns are indicated below:

Field	Card Col.
Dept.	1
Serial No.	3-6
First Initial	10
Middle Initial	11
Last Name	12-24
Type of ded.	32
Deduction Amt.	33-36

Note that the deduction amount is always in the same field (c.c. 33-36). We distinguish between types of deductions by the "type" code that is punched in c.c. 32. For example, Bonds are type 1; Insurance is type 2; Credit Union is type 3; Group Insurance is type 5; all other deductions are uncoded and are lumped in a miscellaneous column.

The total of all deductions is in the last column. Dept., Serial No. and Name would be called indicative information. This is a tabulated report. Figure 8 is the required control panel diagram.

Notes on Figure 8:

A. Serial No. is wired to the comparing magnets to set up our Minor Program Control.

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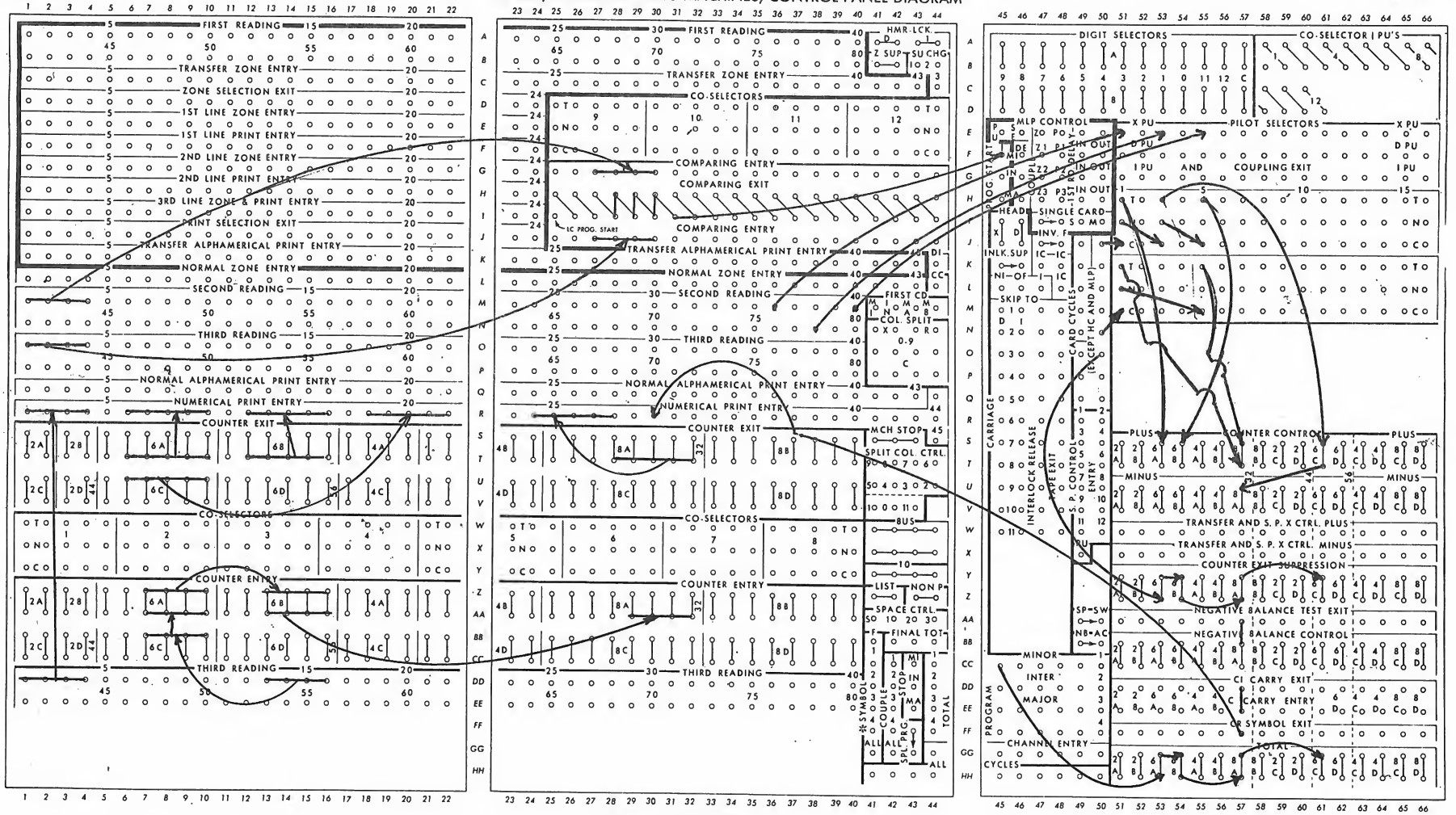
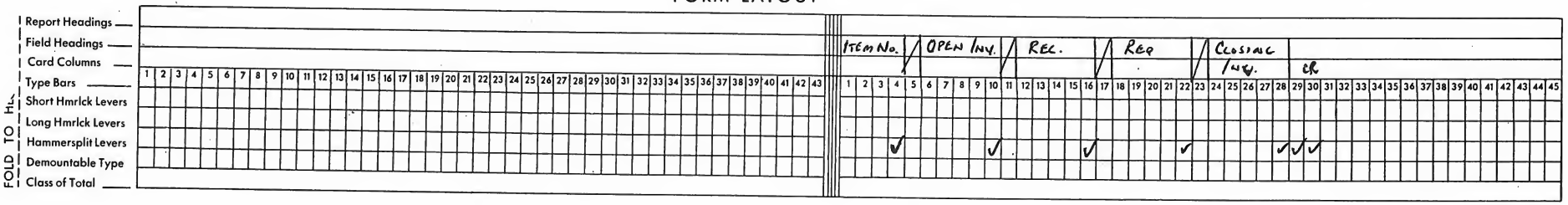


Figure 6.

FORM LAYOUT



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DEDUCTION REGISTER

Dept.	Serial No.	Name	(1) Bonds	(2) Insur.	(3) Credit Union	(5) Group Insur.	(All Others) Miscel. Ded'ns.	Total Ded'ns.
1	206	W V ASTUR	3.75			1.50	4.92	10.17
1	342	F A ATCHISON			2.00	1.25		3.25
1	518	H B BAKER	2.00				2.50	4.50
1	615	L F BILLINGS		2.00		1.50		3.50
1	703	E J BRACKETT	2.50					2.50
1	893	A F CASPER			2.00	1.75		3.75
1	1075	E C COLLINS	1.25			1.25		2.50
1	1103	L F CUNNINGHAM						
1	1219	F A DAVENPORT	1.75				2.00	3.75
1	1302	H F DENNIS				1.00		1.00
1	1741	B A ENGELS						
1	2092	A B FARRELL						
1	2183	M J FOSTER	2.00		2.00	1.25		5.25
1	2470	B J GRAHAM	1.75			1.25		3.00
1	2492	E L GRESHAM	1.75	1.75		1.50		5.00
1	2896	L B HENDERSON	1.75	1.25	2.00	1.75		6.75
1	3720	R J JOHNSON				1.50	10.00	11.50
2	113	F J ACKERLY		1.25			2.25	3.50
2	867	M C CARGIN		1.10				1.10
2	1396	G A DRISCOLL	1.25			1.25	1.00	3.50
2	1569	C L EDWARDS	1.25				2.00	3.25
2	4482	R C MURRAY	1.25	1.00				2.25
2	4891	S C OAKLAND				1.50		1.50
2	6601	P S RUGGLES	1.25				.50	1.75

Figure 7.

B. Employee name is wired as an alphabetic field.

C. The deduction amount field, c.c. 33-36 is wired to the counter entry hubs of six counters (using the common counter entry hubs to get the information from one counter to another.) Note here that although information from the cards will enter all counters, only those counters which receive impulses to add will actually add the information entering them. In order for a counter to add, two things must happen: (1) information must enter the counter; (2) the counter's "plus" hub must receive an impulse.

D. All counter exits are wired to typebars to print our totals.

E. Card column 32 is wired from second reading to the C hub of digit selector 1. Whatever impulse is read from the card will be available from its correspondingly numbered hub. For example, should the card contain a one in c.c. 32, this digit impulse will come out of the 1 hub of the digit selector. It is wired to the DPU hub of pilot selector 8. Note that the DPU hub of a pilot selector will accept any impulse and transfer the selector on the next card cycle. Should the card contain a 2, it will impulse the DPU hub of pilot selector 6; a 3 in the card will "pick-up" pilot selector 4; a 5 in the card will "pick-up" pilot selector 2. Should the card not contain a code in c.c. 32, all selectors would be normal at the time that card passed third reading. Note that only one pilot selector can be in a transferred position for each card - all the rest will be in their normal positions.

F. Counter 8C is wired to add all cards. (This is the total counter.) Counter 4B will add only if none of the pilot

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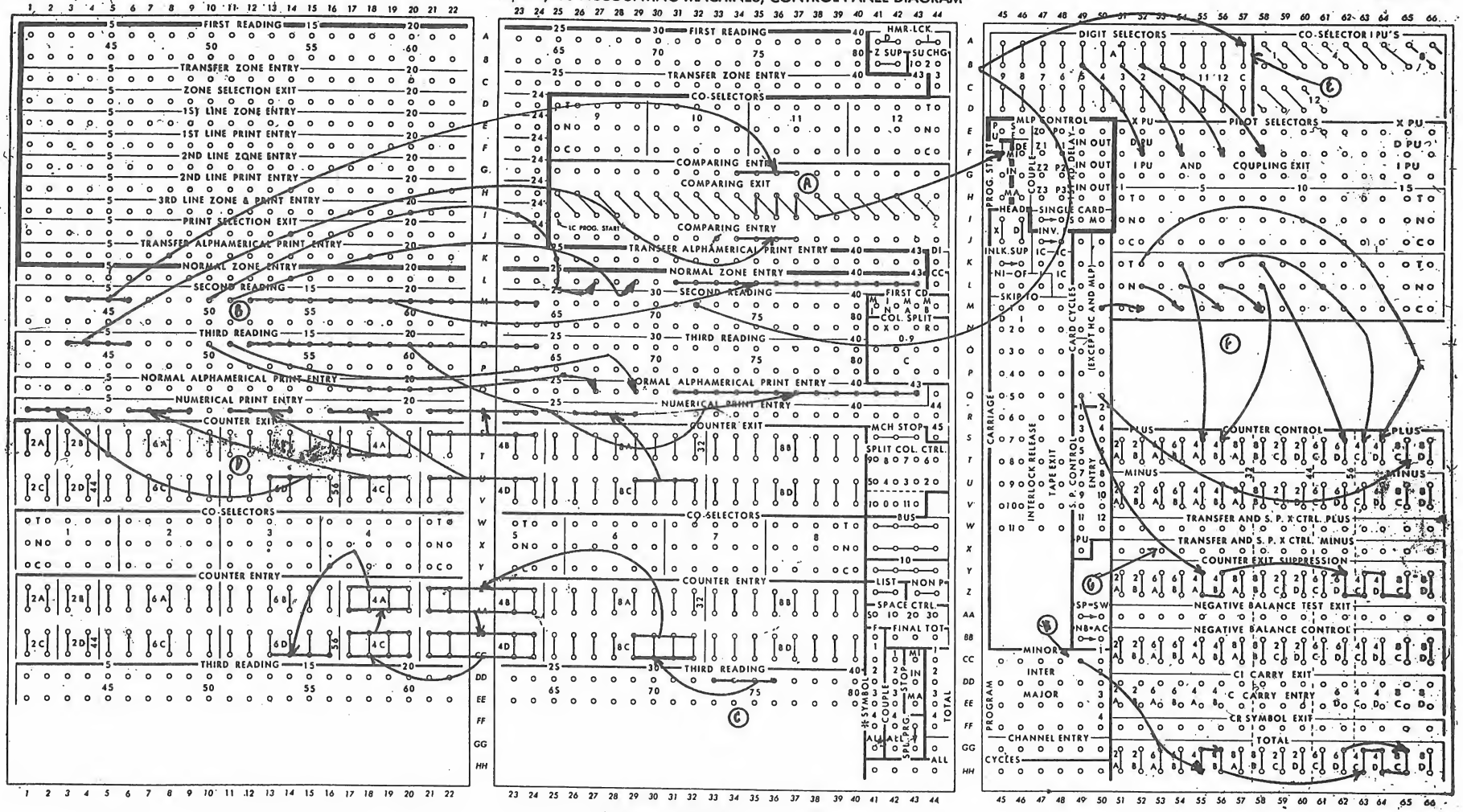
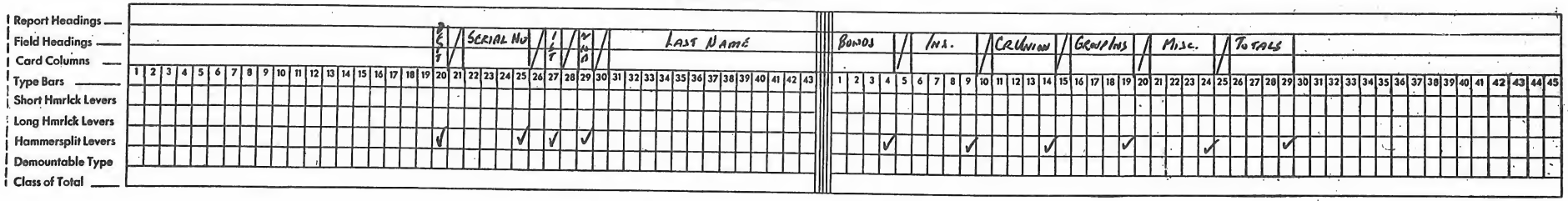


Figure 8.

FORM LAYOUT



selectors is transferred. (4B is the misc. counter.) Counter 6D will add those cards which have a code 1 in c.c. 32. (This is the Bonds counter.) Counter 4C will add those cards which contain the code 2 in c.c. 32. (This is the Insur. counter). Counter 4A will add those cards which have a 3 in c.c. 32. (This is the Credit Union counter). Counter 4D will add those cards which have a 5 in c.c. 32. (This is the Group Insur. counter). Note that whichever selector is transferred will divert the card cycles impulse into the plus hub of a particular counter. If none are transferred, the card cycles impulse will go into Common and out of Normal of each selector until it reaches counter 4B which is the misc. counter.

G. Counter exit suppression of all counters is wired to prevent overprinting.

H. All counters are cleared.

Note that Dept. c.c. 1 should be wired to alpha. t.b. 20; and serial number c.c. 3-6 should be wired to alpha. t.b. 22-25. This wiring has been omitted from the diagram as it would interfere with other functions shown.

EXERCISE 2.

Prepare a control panel diagram to produce a report such as the one shown in Figure 9. This is a tabulated report showing sales by customer for various commodity groups. The fields and card columns are indicated below:

Field	Card Col.
Cust. No.	35-39 (minor control group)
Commodity code	62
Amount	76-80.

The various commodities are punched with distinguishing digit punches. For example, aluminum is code 1, copper is code 2, iron is code 3, and steel is code 4; all other commodities are blank in c.c. 62. The

COMMODITY ANALYSIS #

Customer No.	(1) Aluminum	(2) Copper	(3) Iron	(4) Steel	All Others	Total Sales
2179		31.38	230.67	232.59	2992.27	3768.91
2283	15.30	77.70			1276.25	1369.25
3076	175.63	51.00	306.90	116.50	3875.50	4525.53
4123		4.88	332.55	61.05	1062.82	1461.30
6195		37.00	97.65	391.05	2337.74	2863.44
6843	19.20				584.90	604.10
7792	41.32		363.66	171.45	419.76	996.19
8062	44.28	301.75	131.20	277.29	486.51	1241.03
8257	32.40		123.30	577.17	145.00	877.87
10723	73.80				72.50	146.30
11234	229.96	224.02	666.65	219.80	2023.30	3363.73
11905		96.04			540.12	636.16
11975	69.12	10.82	217.68	161.00	217.28	675.90
14910	41.70	77.70	123.75		342.10	585.25
15005	129.61	267.90	118.80		765.63	1281.94
15035	2.49	8.88	106.85		130.04	248.26
16771	27.00				997.50	1024.50
19285	36.26		55.80		432.00	524.06
19905				162.80		162.80
29031	198.00				131.40	329.40
29134		44.25				44.25

Figure 9.

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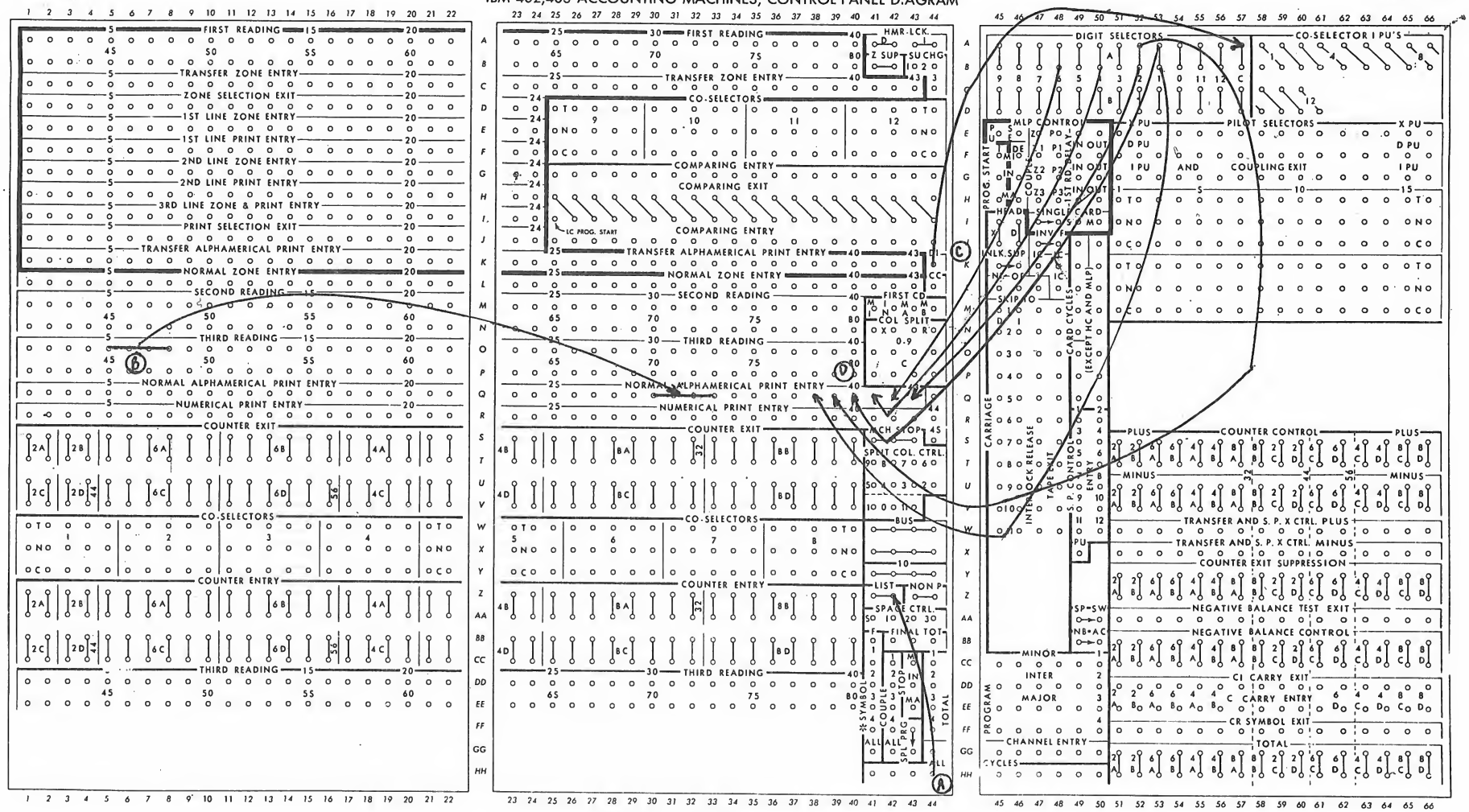
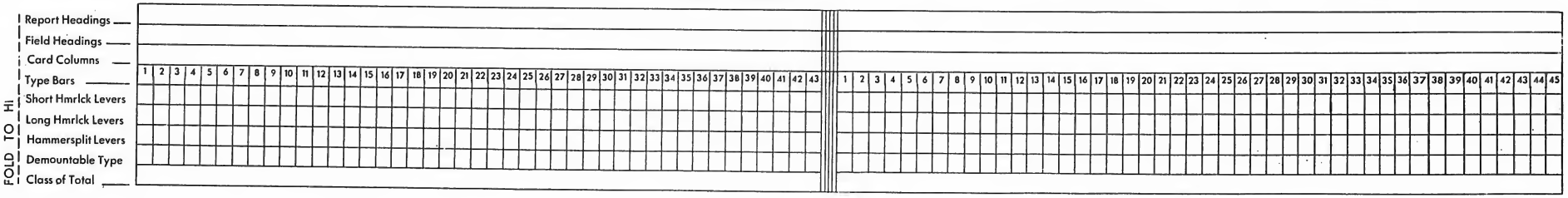


Figure 10.

FORM LAYOUT



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cards have been sorted into sequence by customer number.

Use counter 6A for aluminum sales; counter 6C for copper; counter 6B for iron; counter 6D for steel; counter 8A for all others; and counter 8B for total sales.

Print customer no. in alpha t. b. 39-43; aluminum sales in num. t. b. 1-6, copper in num. t. b. 8-13; iron in num. t. b. 15-20; steel in num. t. b. 22-27; all others in num. t. b. 29-34; and total sales in num. t. b. 36-41.

16.3 EMITTING

The digit selector can be used as an emitting device in conjunction with the "DI" hub, K, 44. This hub emits all twelve zone impulses for every card cycle. Assume that we want to emit the constant date Dec. 14, 1962 for every card passing through the machine, this constant to be printed in alpha. t. b. 38-43. We would emit 121462 as the constant. Figure 10 illustrates the correct control panel wiring.

Notes on Figure 10:

A. All cycles is wired to list.

B. c. c. 5-8 is wired to print in alpha. t. b. 30-33.

C. The DI impulse is wired to the C hub of digit selector 1.

D. The date "121462" is emitted.

If this had been a tabulated report, the emitted information would print once for each control group as indicative information.

16.4 CARD COUNT

There are times when we are interested in knowing how many cards are in each control group or in the entire report. The "CC" hub L, 44, emits a one (1) impulse for each card cycle which can be added just as information from cards is added. Assume that we have a file of cards sorted into sequence by employee number, c. c. 16-19. We want to add the earnings field for each employee (c. c. 50-53) and we also want to know how many cards each employee has in this report. Figure 11 illustrates the correct control panel wiring for this job.

Notes on Figure 11:

A. c. c. 16-19 are wired to comparing magnets to set up program control.

B. c. c. 16-19 are wired to num. t. b. 1-4 as indicative information.

C. The earnings field is wired to counter entry of 6A.

D. The CC impulse is wired to counter entry of 8B to cause a digit 1 to enter the counter for each card.

E. Both counters are impulsed to add every card.

F. Both counters are suppressed as this is a tabulated report.

G. Both counters are cleared at minor time.

H. The counters print their totals. A one will be added in counter 8B for every card in the minor group.

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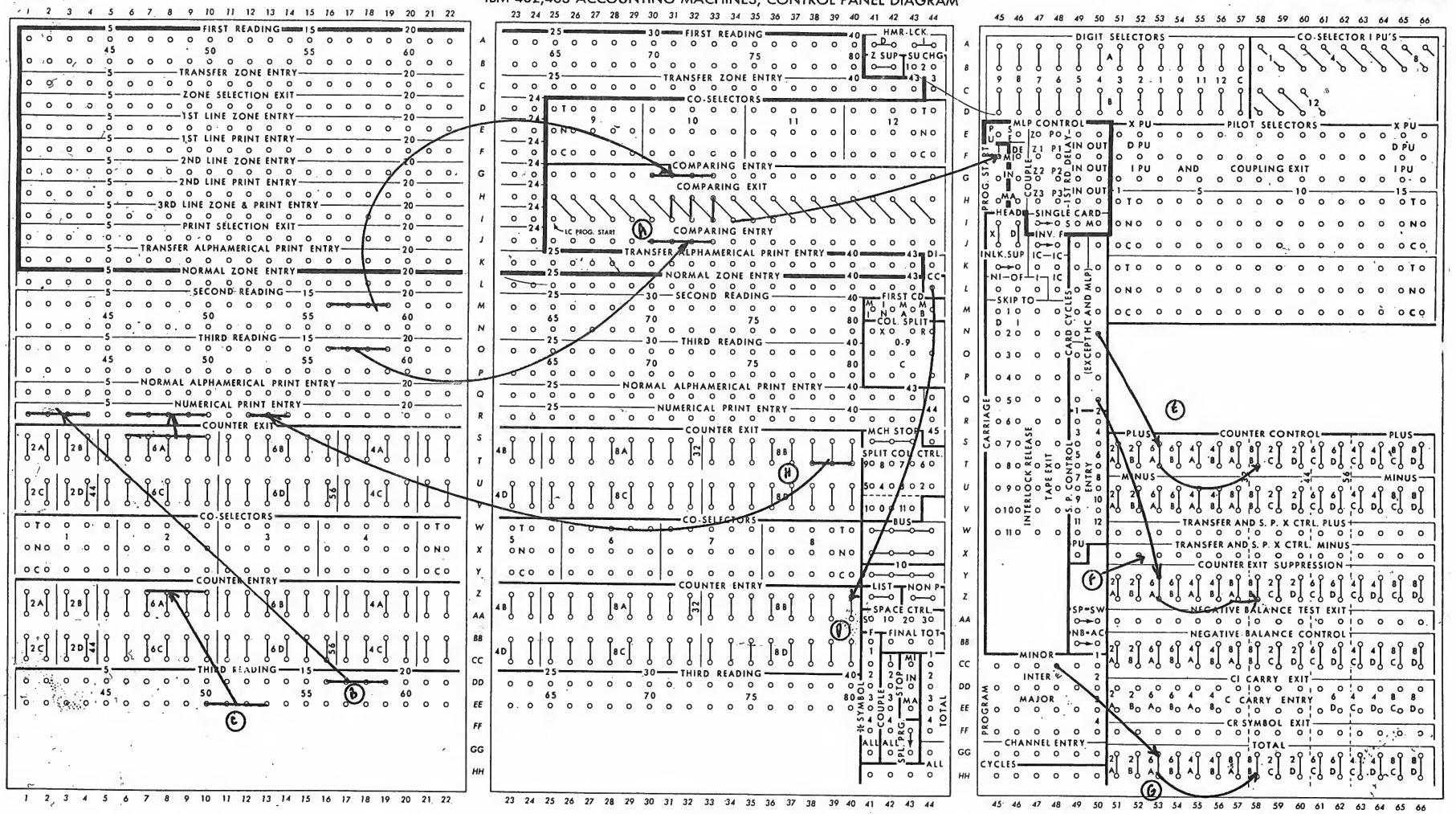
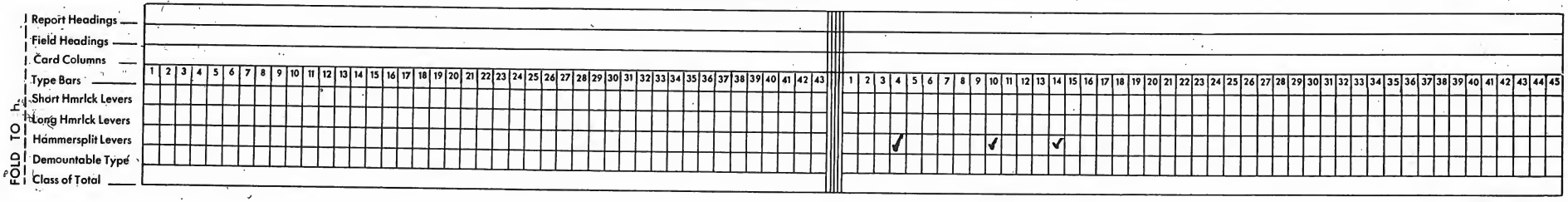


Figure 11.

FORM LAYOUT



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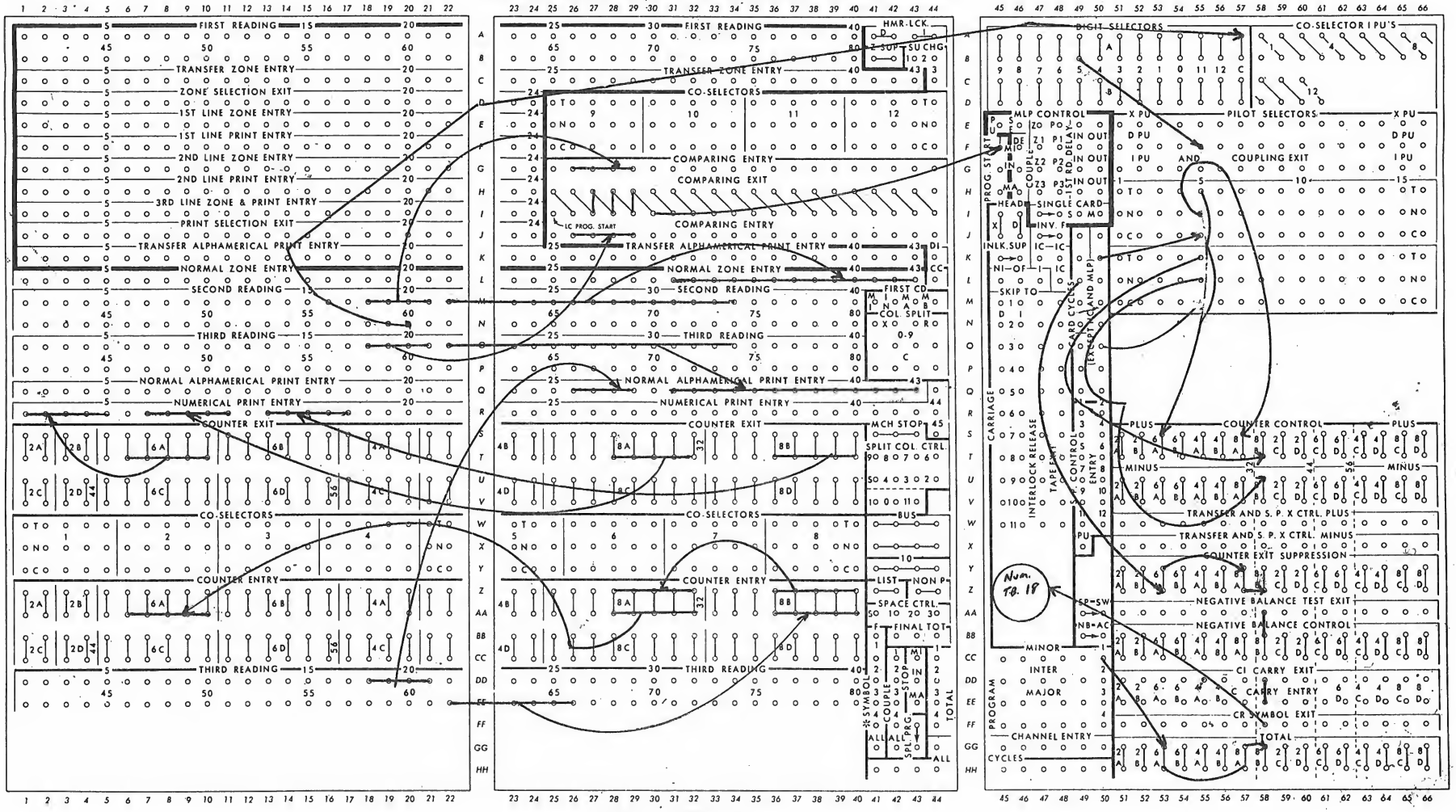

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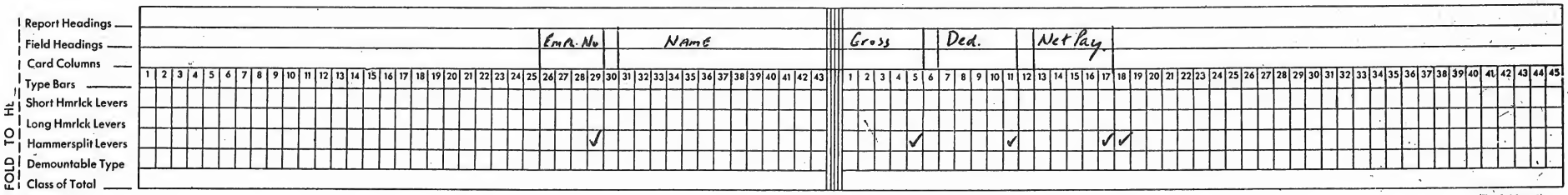

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Solution to Exercise 1.

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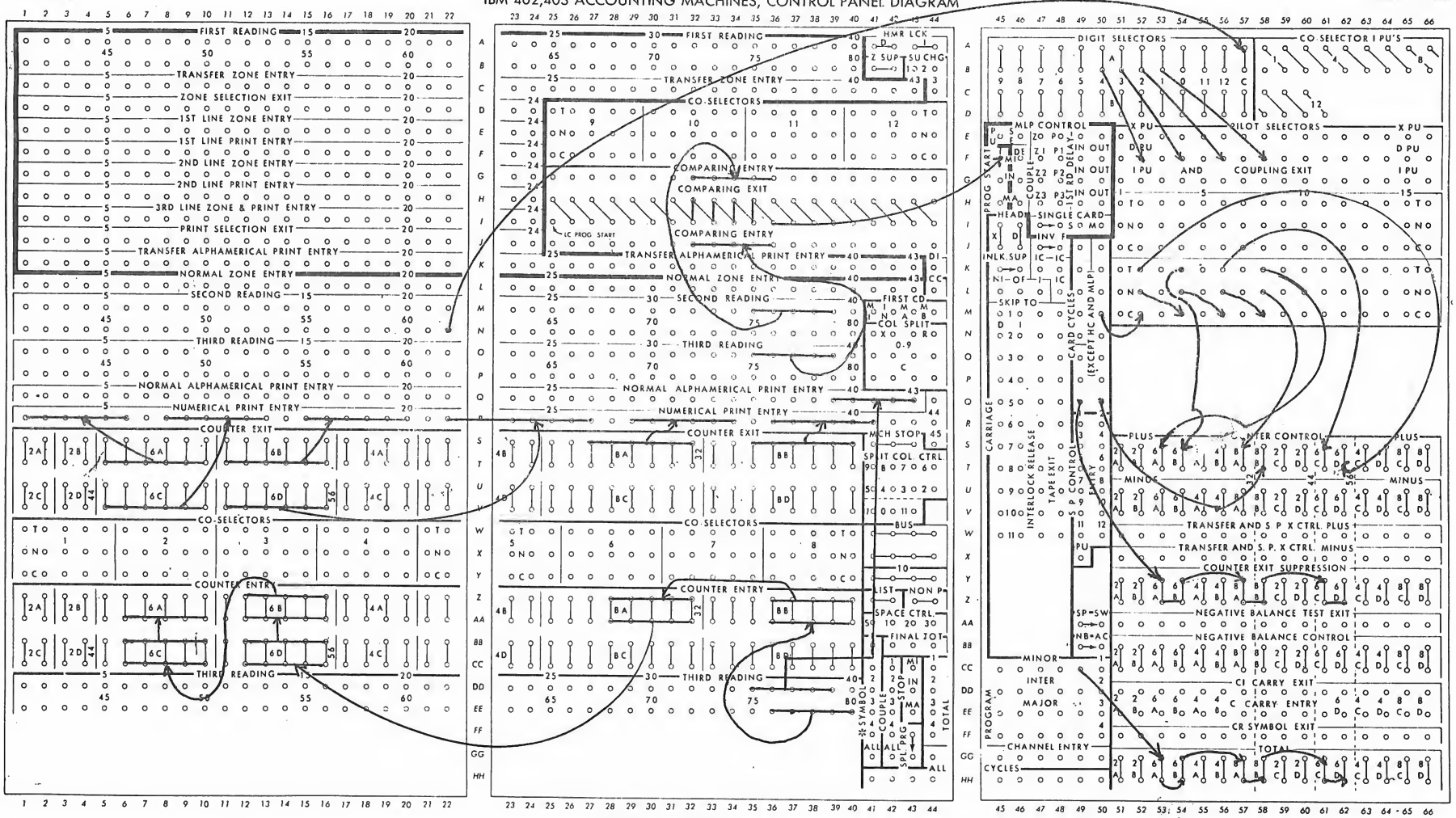
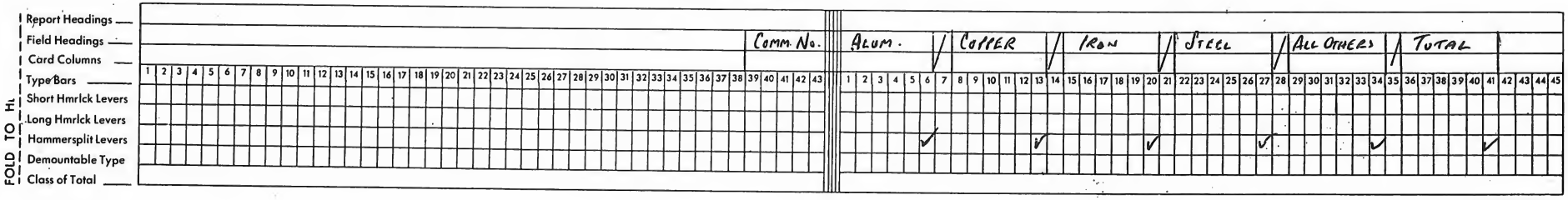


Solution to Exercise 2.

FORM LAYOUT



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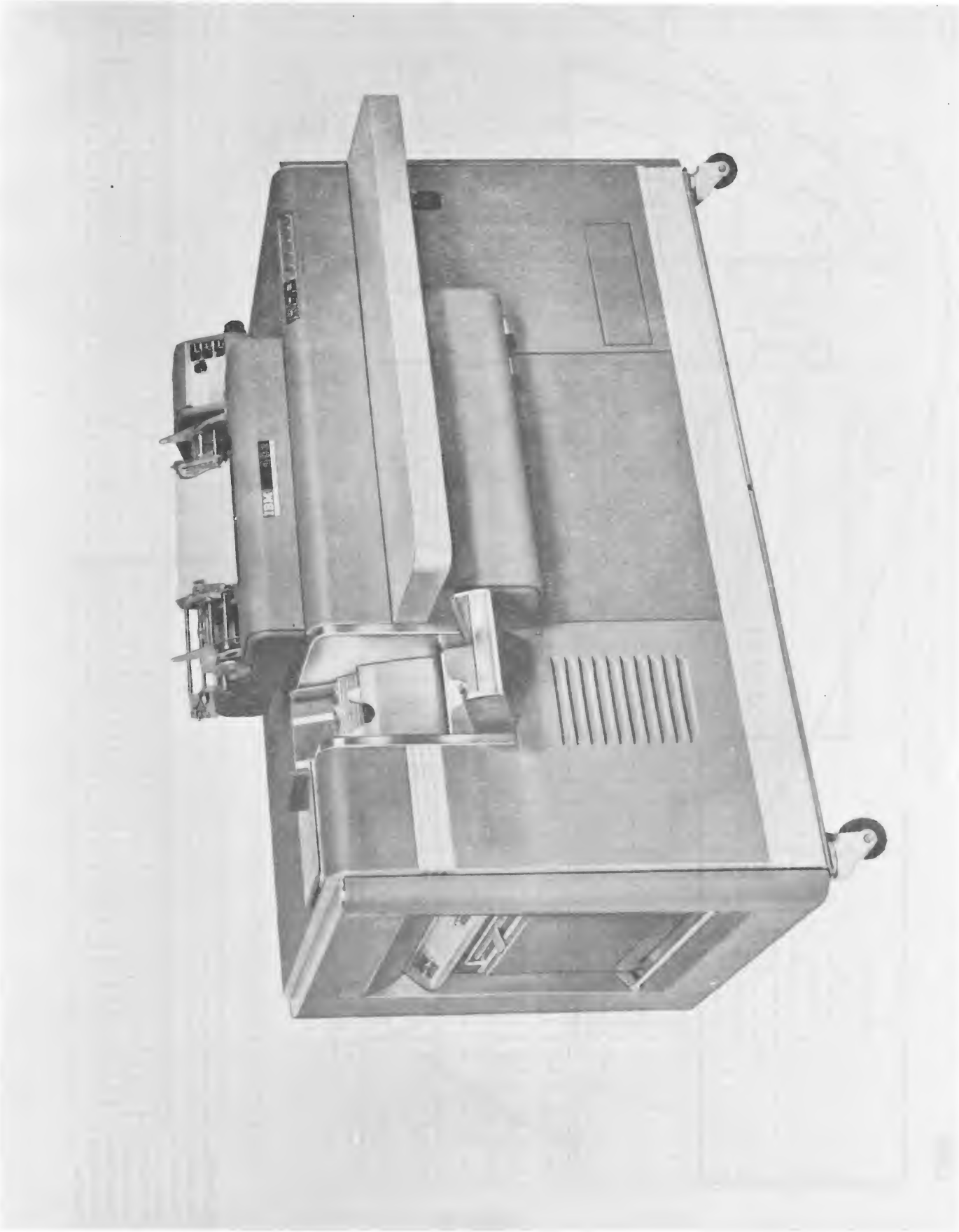

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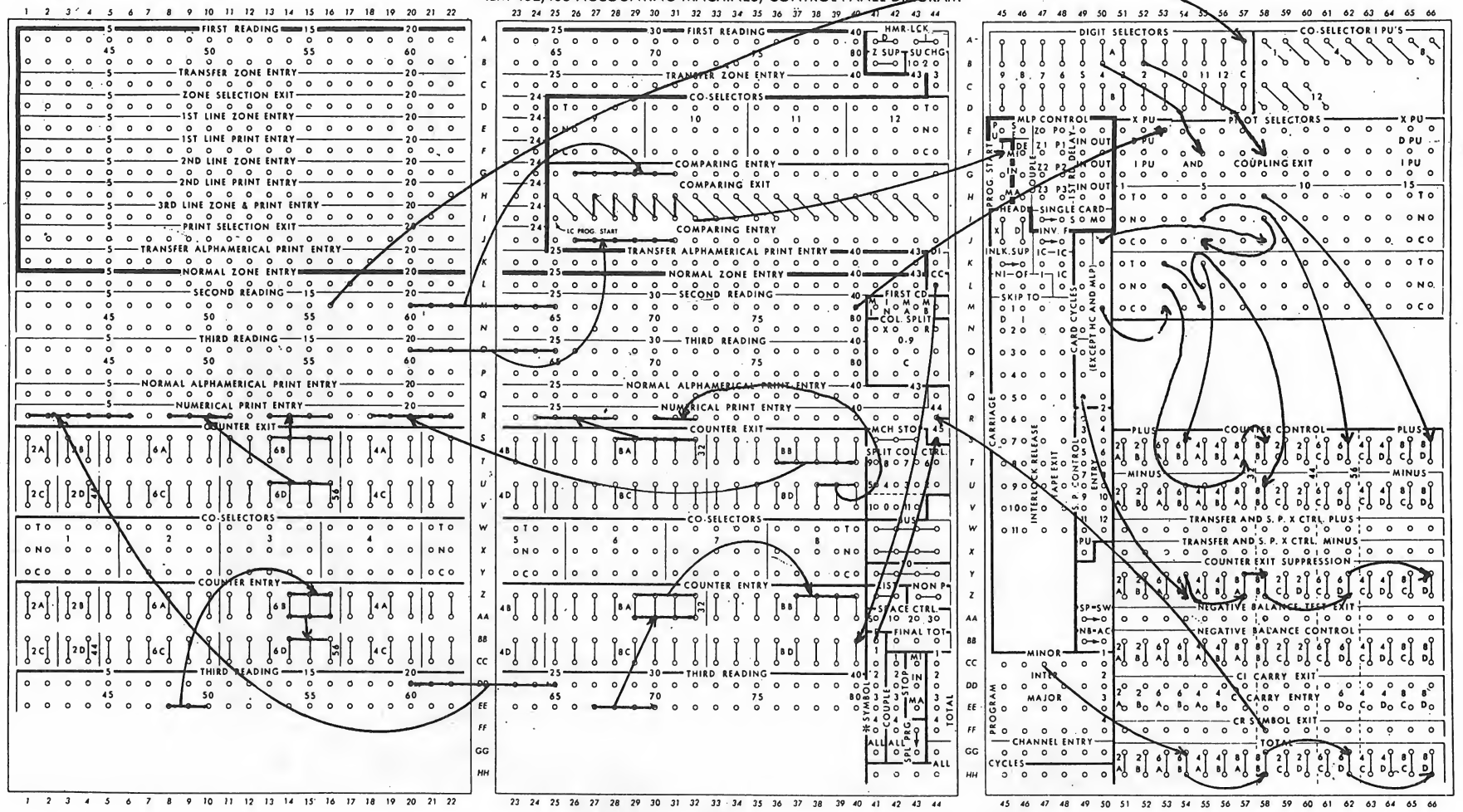
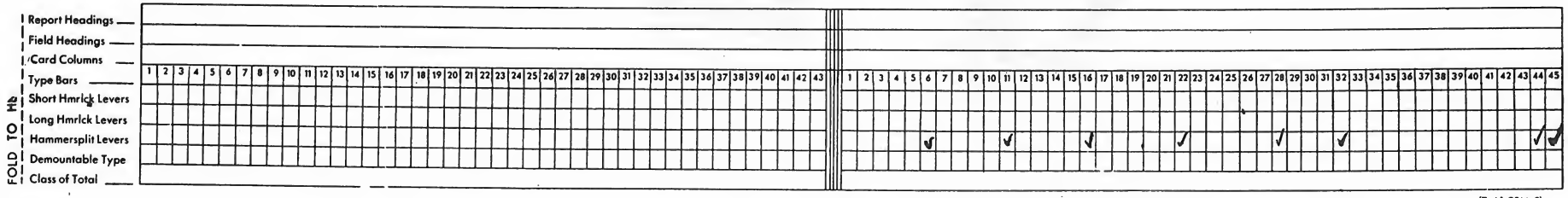


Figure 12.

FORM LAYOUT



(7-61:20M-S)

Refer to Figure 12. Answer the following questions True or False. If True mark an X in Box A; if False, mark an X in Box B.

1. Minor program control is on c.c. 21-26.
2. Counters 8A and 8B will add and subtract at the same time.
3. This is a tabulated report.
4. Counter 6B will add only those cards which have an X punch in c.c. 40 and a digit 4 in c.c. 16.
5. Counters 8A and 8B will add those cards which have an X punch in c.c. 40.
6. Counter 8B will subtract those cards which have an X punch in c.c. 40 and the digit 4 in c.c. 16.
7. Counter 8B is wired properly for subtraction.
8. A CR symbol will print from num. t.b. 44 every time counter 8B subtracts.
9. Counter 8D is adding cards which have a digit 2 in c.c. 16.
10. Counter exit suppression is wired correctly.
11. The counters are being cleared properly.
12. Counter 6D will add those cards which have neither a digit 4 or a digit 2 in c.c. 16.
13. An asterisk will be printed in numeric t.b. 45 at the time the minor total prints.
14. The proper hammersplit levers are indicated.
15. To change this to a detail printed report, it is enough to wire all cycles to list.

I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING

LESSON #17

TABLE OF CONTENTS

ELECTRONIC COMPUTER PROGRAMMING INSTITUTE

17.1 MULTIPLE PROGRAM STEPS

The problems discussed to date were those in which the 402 was required to execute a single program step (Minor). We have also discussed the use of the Final Total hubs, but this type of a total is considered to be a manual rather than an automatic total.

There are three possible automatic programmed totals: minor, intermediate and major. The program start hubs are located on the panel at F-H, 45. The use of these hubs will be discussed in the problem that follows.

PROBLEM: Assume that a company operates a chain of stores in a particular city. For each sale made, a sales check is created (our source document). All sales checks for all stores are forwarded to the central IBM data processing department where cards are punched from the sales checks. For each sales check a card is punched which contains the following fields:

Field No.	Card col.
Store No.	1-3
Department	5-8
Salesman No.	10-11
Amount of Sale	20-24

We want to prepare a report which indicates how much each salesman has sold, how much each department has sold, and how much each store has sold. We could do this now, with the information we have, if we were to run three separate reports. First we would sort our cards into sequence by salesman number and run a report accumulating sales by salesman number; then we would sort our cards by department number and run a second report accumulating sales by department; then we would sort our cards into sequence by store number and run a third report accumulating sales for each store. This means that we would have to run all our cards through the 402 three times.

We can avoid this multiple running by making use of our three program steps. Our cards would first be sorted into sequence by salesman number. This is called the minor sort; they are then sorted by department number - this is called the intermediate sort; they are then sorted by store number - this is called the major sort. Our cards would now be in sequence by store number, within store by department, and within department by salesman.

Our sample report is illustrated in Figure 1 and the required control panel diagram is shown in Figure 2.

Store No.	Dept. No.	Sls. No.	Amount of Sale
12	145	16	24500
12	145	23	5690
			30190*
12	256	65	56055
12	256	67	2500
12	256	87	10020
			68575*
			98765 *
23	100	11	16700
23	100	54	2800
			19500*
23	104	76	67500
			67500*
23	175	34	6500
23	175	35	12400
23	175	64	34500
			53400*
			140400 *

Figure 1.

Notes on Figure 2:

A. This is a tabulated report. Our three indicative fields are wired to the typebars.

B. Store number, c.c. 1-3 are wired to the comparing magnets and the unequal impulse is wired to Major Program Start.

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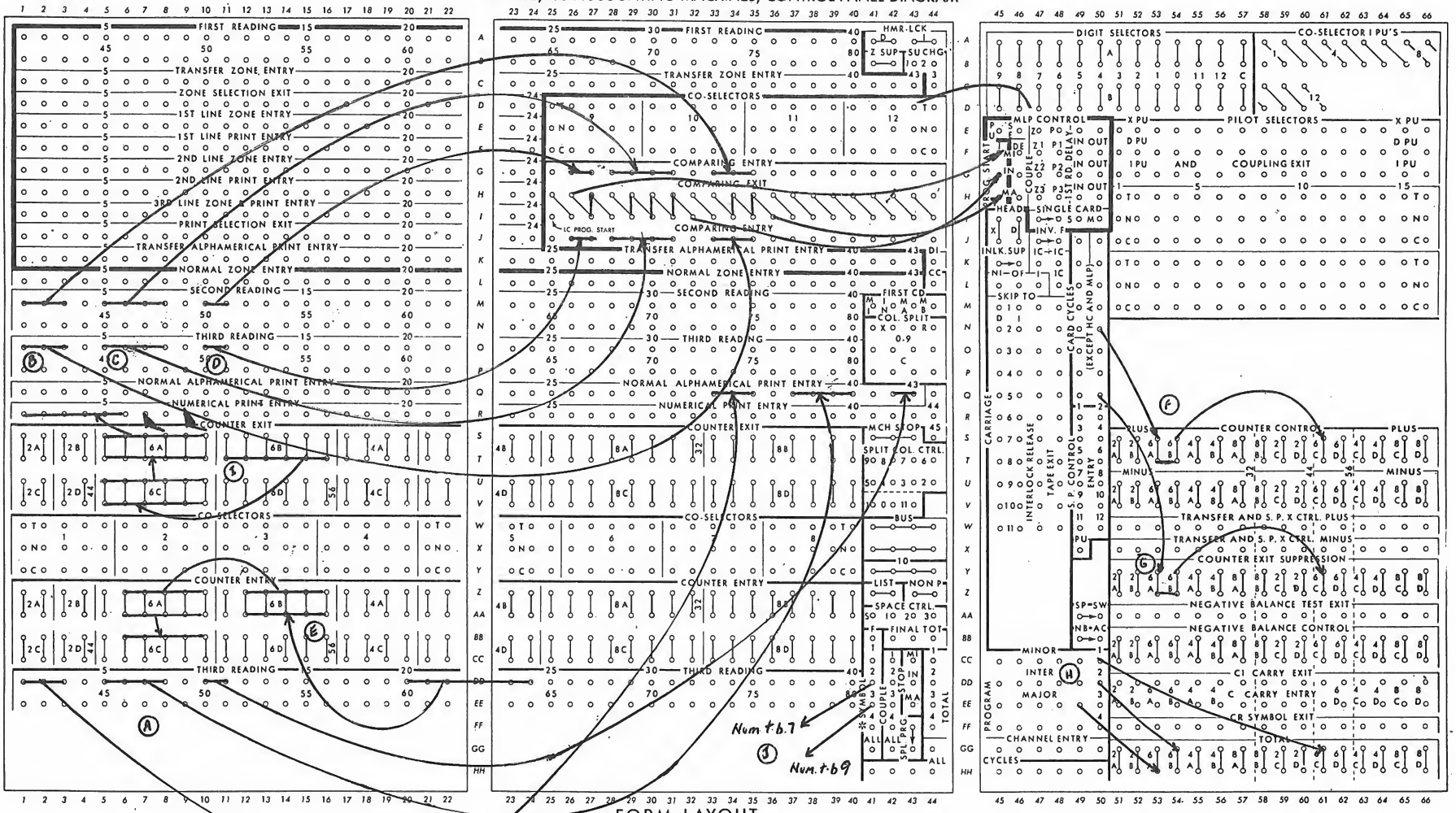
IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM



FORM LAYOUT

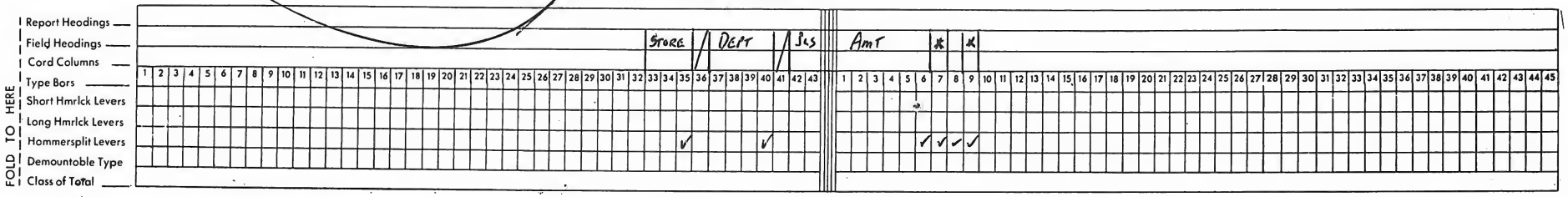


Figure 2.

C. Department number, c.c. 5-8 are wired to the comparing magnets and the unequal impulse is wired to Intermediate Program Start.

D. Salesman number, c.c. 10-11 are wired to the comparing magnets and the unequal impulse is wired to Minor Program Start. Our three program steps are set up. Note here that every time Intermediate Program Start is impulsed, it forces a minor program cycle to take place; and every time the Major Program Start hub is impulsed, it forces the minor and intermediate program cycles to take place. This is done automatically by the machine.

E. Our amount field is wired to all three counters. Counter 6C is adding our minor totals (by salesman); counter 6B our intermediate totals (by department); and counter 6A our major totals (by store number.)

F. All counters are impulsed to add every card.

G. All counters are suppressed.

H. Counter 6C will clear when minor program start is impulsed. Its total will print in num. t.b. 1-6. The other two counters will retain their totals. No asterisk will print. When intermediate program start is impulsed, it will force a minor total cycle to clear counter 6C. Then counter 6B will clear and print. At this time, an asterisk will print in num. t.b. 7. When major program start is impulsed it will force both minor and intermediate total cycles to clear and print 6C and 6B. Then the 402 will execute a major program cycle at which time 6A will clear and print and an asterisk will print in num. t.b. 9.

I. Whichever counter is cleared will print its total in numeric t.b. 1-6 through the common counter exit hubs.

J. Symbol hub 2 will emit at intermediate time to print an asterisk in num. t.b. 7; symbol hub 3 will emit at major time to print an asterisk in num. t.b. 9.

By wiring our solution to this problem in the manner illustrated, we leave room for one area of error. Since IBM machines are as the name indicates, merely "machines," they will from time to time break down and possibly give faulty answers. Assume that counter 6C was performing inaccurately - we could get a result such as this:

Amount of Sale
25500
5790
30190*

Our intermediate total would be correct since it is being accumulated in counter 6B. However, our minor totals are incorrect (they should appear as shown in Figure 1). Any of our counters could be mal-functioning. This would give us incorrect results and we want to avoid it. Assume that we knew that our overall total for the entire run was 239165. We could prove our major totals by adding them all together; then we would have to prove our intermediate totals by adding them all together; then we would have to prove our minor totals by adding them all together. This is something we want to avoid doing and we can, using a technique called "total transfer."

17.2 TOTAL TRANSFER

This technique permits one counter to accumulate information directly from cards; all other counters which are to add the same field merely add totals from the counter which has accumulated the information from the cards. Figure 3 is a revised control panel diagram showing the wiring required to produce the report shown in Figure 1, using the total transfer method. On all problems which follow this one, we will always use the total transfer method.

Notes on Figure 3:

Only those portions of the solution which have changed are shown. All other require-

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IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM

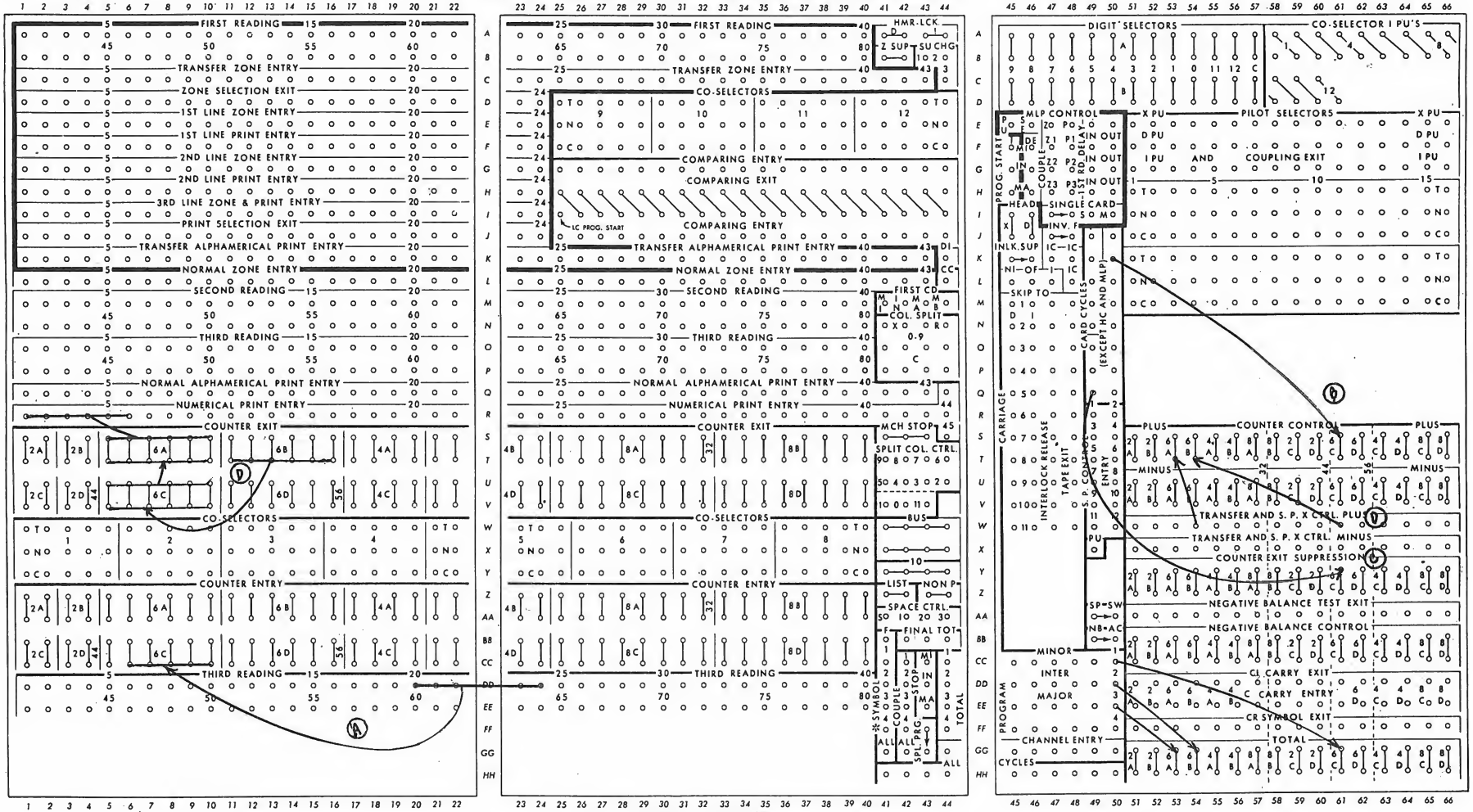
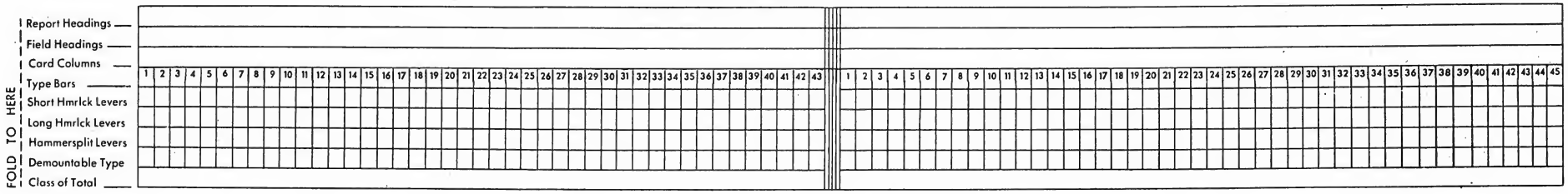


Figure 3.

FORM LAYOUT



ments of the problem would be handled as illustrated in Figure 2.

A. Information from the cards will enter the counter entry hubs of counter 6C only.

B. Counter 6C is impulsed to add every card.

C. Counter 6C is suppressed at the time cards are being read.

D. Every time a counter clears and it contains a positive total, an impulse is emitted from its Transfer and S.P.X. Ctrl. Plus hub (W, 51-66.) Should the counter be negative at the time it clears, an impulse would be available from its Transfer and S.P.X. Ctrl. Minus hub (X, 51-66). These impulses are going to be used to cause other counters to add.

Remember, in order for a counter to add, information must enter the counter and the counter must receive an impulse to add. At minor time, counter 6C clears. The total in the counter reaches the typebars and also enters the counter exit hubs of counters 6A and 6B through the common counter exit hubs. At the same time the counter transfer plus hub of 6C emits an impulse which is wired to the plus hub of counter 6B. Information can enter a counter either through its entry or exit hubs. At this time, counter 6B will add the total which enters it. This is the same minor total which is being printed.

At the time counter 6B clears, the intermediate total enters 6A and at this time 6A receives an impulse to add from counter 6B's transfer plus hub. Counter 6C adds information from cards; counter 6B adds the minor totals being accumulated in 6C; and counter 6A adds the intermediate totals being accumulated in counter 6B. Now, if the major totals are added and they prove to our control total (239165), we know that all the intermediate and minor totals are correct since they were used to develop the major total.

Let us examine another problem.

SAMPLE PROBLEM:

A company operates a number of factories each of which produces various types of merchandise. We are interested in knowing how much each factory's dollar sales are, how much of each merchandise type has been sold and total sales for all factories. Our sales cards contain the following fields:

Field	Card col.
Factory No.	6-7
Type merch.	8-9
Salesman No.	17-19
Amount of Sale	30-34

Credits are punched in the same format but have an X in c.c. 75.

Our sample report is shown in Figure 4 and the required control panel diagram is illustrated in Figure 5.

Factory	Type	Amount
1	16	76875
1	20	5475CR
1	35	145650
1	67	45600
		262650 *
4	16	30000
4	20	55000
4	32	1625CR
4	35	140000
4	67	25000
		248375 *
		511025

Figure 4.

Notes on Figure 5:

A. **Factory number is wired as intermediate** program; type merchandise as minor. Since we want an overall total, we use the LC Prog. Start hub (I, 25). This hub emits an impulse after the last card passes third reading. In this case, it is wired to major program **start.**

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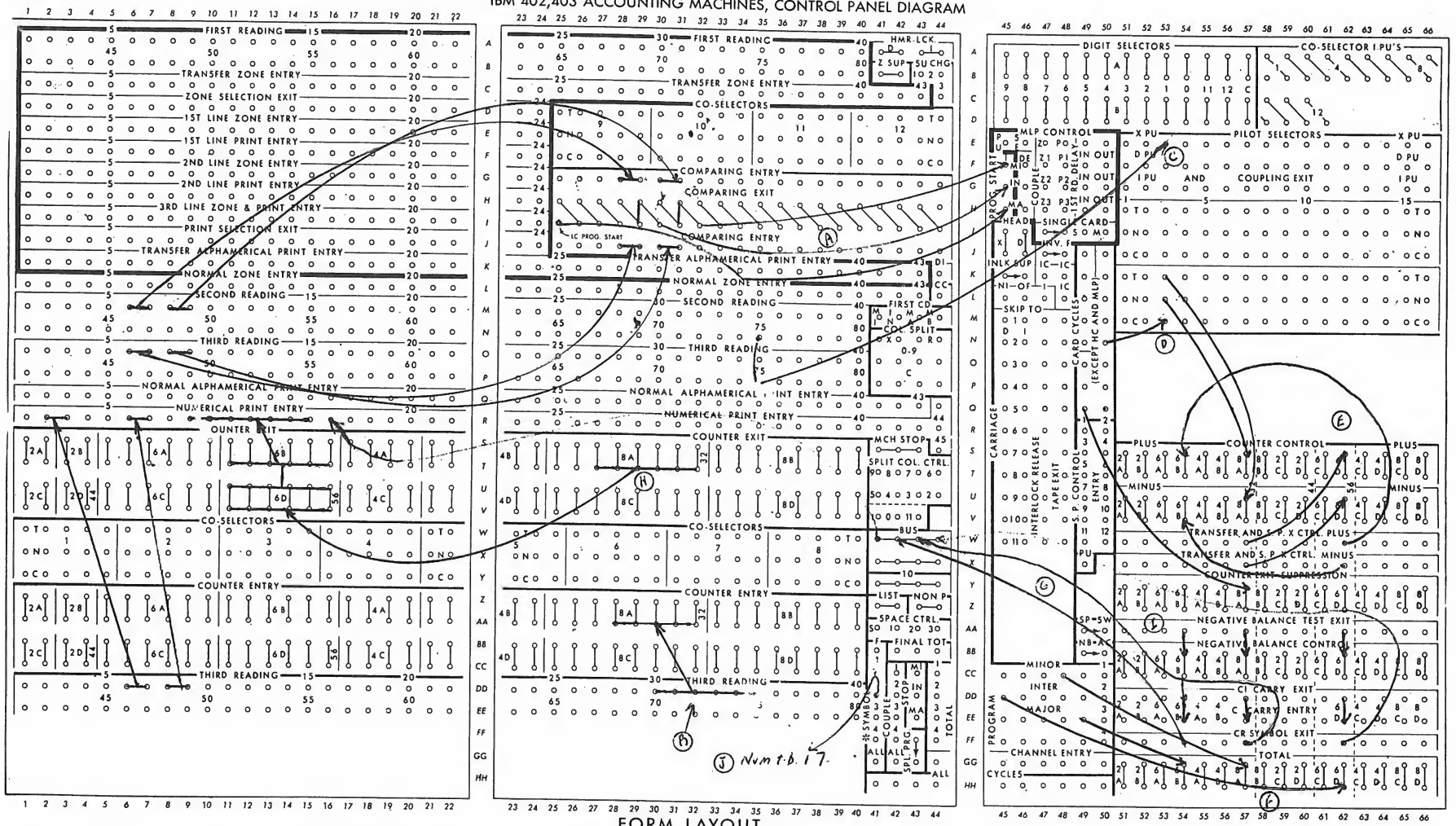

FORM LAYOUT

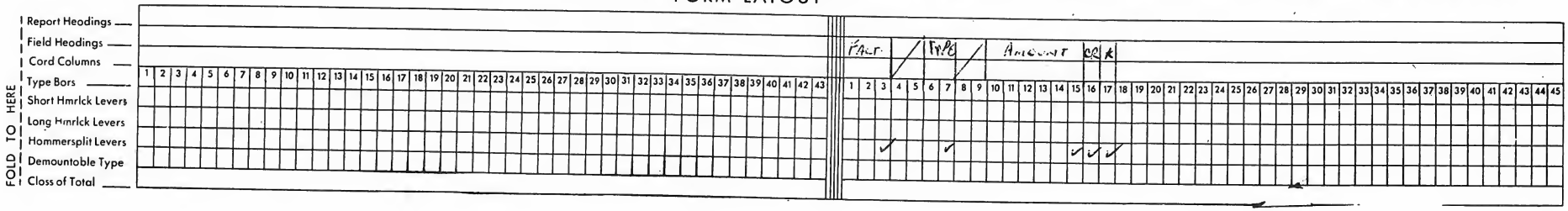

Figure 5.

B. Our amount field enters counter entry of our minor counter, 8A.

C. Our pilot selector is picked up from second reading brush 75.

D. Counter 8A is impulsed to add NX 75 cards and to subtract X 75 cards.

E. Our other counters are wired to add and subtract from the transfer plus and minus hubs. When 8A clears and it is plus, its total will add in 6D; when 8A clears and is minus, its total will subtract in 6D; when 6D clears and is plus, its total will add in 6B; when 6D clears and is minus, its total will subtract in 6B.

F. The counters are cleared with their respective program exit impulses.

G. Should any of the three counters be minus at the time it clears, a CR symbol will print in num. t.b. 16. CR symbol exit hubs of all three counters are wired to the common bus hubs and from there to the typebar.

H. Our counters are wired to clear.

I. Negative balance test exit is wired to negative balance control, and CI is wired to C for all counters which are subtracting.

J. An asterisk is printed from num. t.b. 17 at intermediate time.

EXERCISE 1.

Prepare the control panel diagram required to print the report illustrated in Figure 6. The card format is indicated below.

Field	Card col.
Employee No.	1-4
Department	8-10
Gross Earnings	65-69

Deductions are in the same card columns as gross earnings, but they have an X in c.c. 38.

This is a tabulated report. We are to accumulate gross earnings, total deductions and net earnings for each employee and by department. Our cards have been sorted first by employee number and then by department. You can assume that net earnings can never be a minus figure. Our maximum size totals can never exceed six figures. The solution to this problem will be found at the end of this lesson.

A variation of a total transfer problem occurs when we wish to print our intermediate or major totals in typebars other than the typebars used to print minor totals. Figure 7 illustrates the desired report and Figure 8

Dept.	Empl.#	Gross	Deductions	Net Pay
131	1234	6500	610	5890
131	1345	10000	2300	7700
		16500*	2910*	13590*
145	567	8000	1050	6950
145	569	9000	760	8240
145	570	10000	2200	7800
		27000*	4010*	22990*
		Minor ctr 6A	6C	8A
		Int. ctr 6B	6D	8B
		Print in - num. tb. 1-6	9-14	17-22

Figure 6.

Store No.	Dept. No.	Sls. No.	Sales by salesman	Sales by Dept.	Sales by Store
12	145	16	24500		
12	145	23	5690		
				30190	
12	256	65	56055		
12	256	67	2500		
12	256	87	10020	68575	
					98765
23	100	11	16700		
23	100	54	2800		
				19500	
23	104	76	67500		
				67500	
23	175	34	6500		
23	175	35	12400		
23	175	64	34500		
				53400	
					140400

Figure 7.

the required control panel. The fields and card columns are as follows:

Field	Card cols.
Store No.	1-3
Department	5-8
Salesman	10-11
Amount of Sale	20-24

This is a problem similar to the one discussed earlier in this lesson and illustrated by Figures 1 & 3. The differences will be discussed in the notes that follow:

Notes on Figure 8: (Only those portions of the diagram that are new will be discussed here.)

A. The amount field from the card enters counter 6A; the counter is impulsed to add from card cycles and is also suppressed.

B. When 6A clears (at minor time) its total prints from num. t.b. 1-6 and also enters the entry hubs of counter 6B. At this time, 6B is impulsed to add from the transfer plus hub of 6A. Note here that the counter exit suppression hub of 6B is impulsed with a minor program exit impulse to prevent the minor total which is entering the entry hubs from coming out of the exit hubs at this time and printing.

C. At intermediate time, counter 6B will be cleared and print. The intermediate totals will enter the counter entry hubs of counter 8A which is impulsed to add from the transfer plus hub of 6B. At this time, counter exit suppression of 8A is impulsed from intermediate program exit so that the total entering the entry hubs will not print. Counter 8A totals will print at major time.

The important point to note here is that our totals are transferred from the exit hubs of one counter to the entry hubs of another. To prevent the information which is entering the entry hubs from printing at this time, the counter's exit suppression hub is impulsed at the same time the counter's plus hub is

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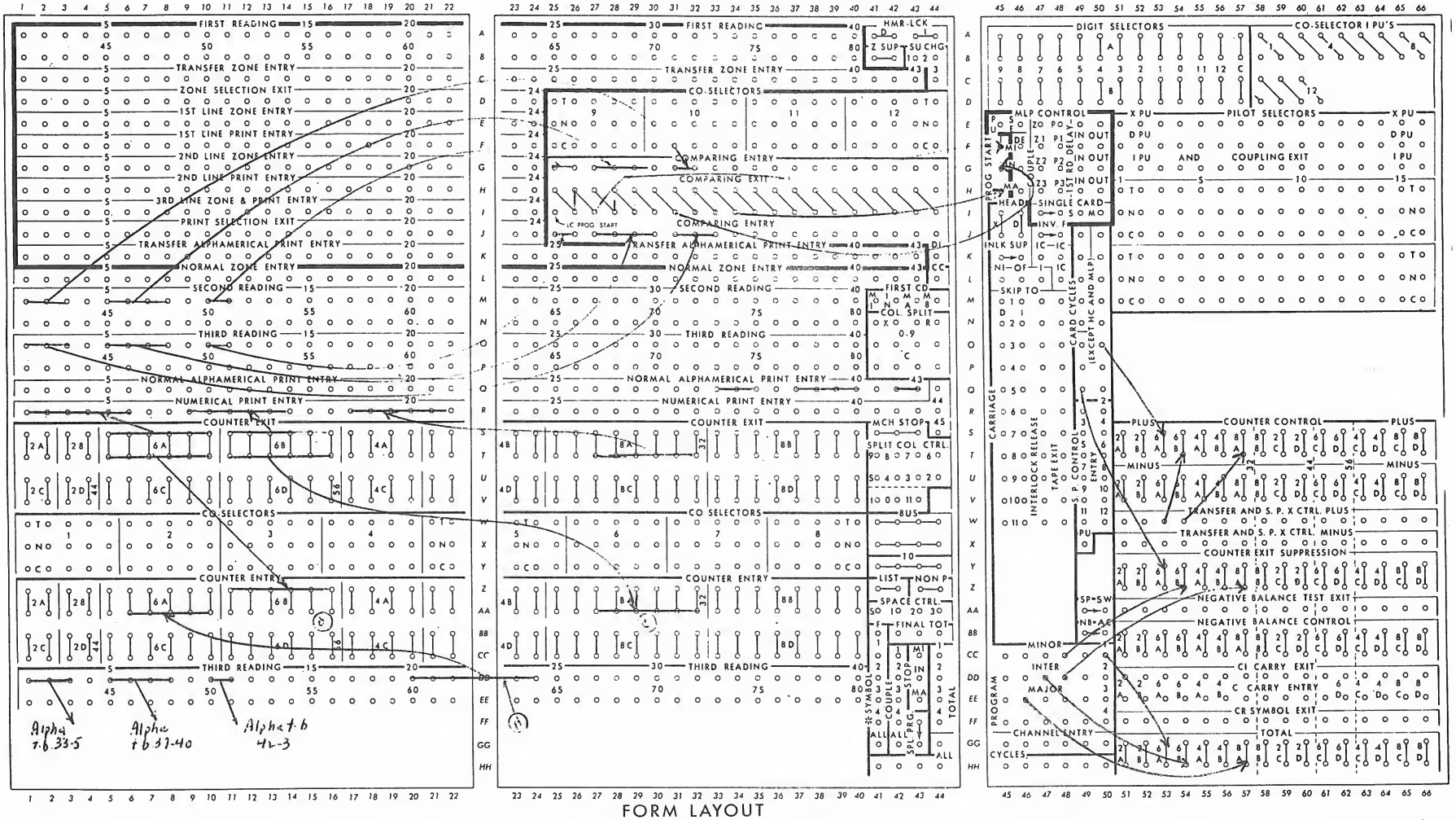

FORM LAYOUT

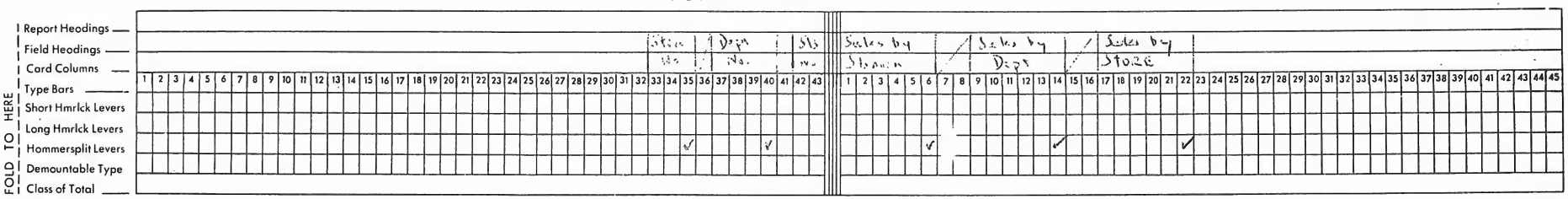

Figure 8.

impulsed. Although different impulses are used, they are emitted by the machine at the same time.

17.3 GROUP INDICATION

Group indication is a technique used to eliminate repetitive printing of indicative data. Compare Figure 9 (a report printed using group indication) with Figure 7. Both reports are essentially the same except for the format chosen. In Figure 7 our indicative information is printed for every line on the report. In Figure 9, we print our indicative information only when it changes. Figure 10 is the control panel diagram required to produce the report illustrated in Figure 9. Notes on Figure 10 appear below. The method used here to achieve group indication is called the "counter" method. In the next lesson, we will discuss another method, the "selector" method.

Store No.	Dept. No.	Sls. No.	Sales by salesman	Sales by Dept.	Sales by Store
12	145	16	24500		
		23	5690		
				30190	
	256	65	56055		
		67	2500		
		87	10020		
				68575	
					98765
23	100	11	16700		
		54	2800		
				19500	
	104	76	67500		
				67500	
	175	34	6500		
		35	12400		
		64	34500		
				53400	
					140400

Figure 9.

Notes on Figure 10: (Only those parts of the problem that are new will be discussed here.)

A. The fields which are to be group indicated are wired into counter entry of the selected counters. Note here that any counters may be used provided they are large enough to accommodate the field. The counter exits are wired to the typebars.

B. We want to indicate our major control group just once, on the first line of that group; we also want to indicate our intermediate control group once on the first line of each intermediate group. Our basic principle governing counter use is that a counter will add only when (1) information enters the counter, and (2) when the counter receives an impulse to add. At that time, the information entering counter

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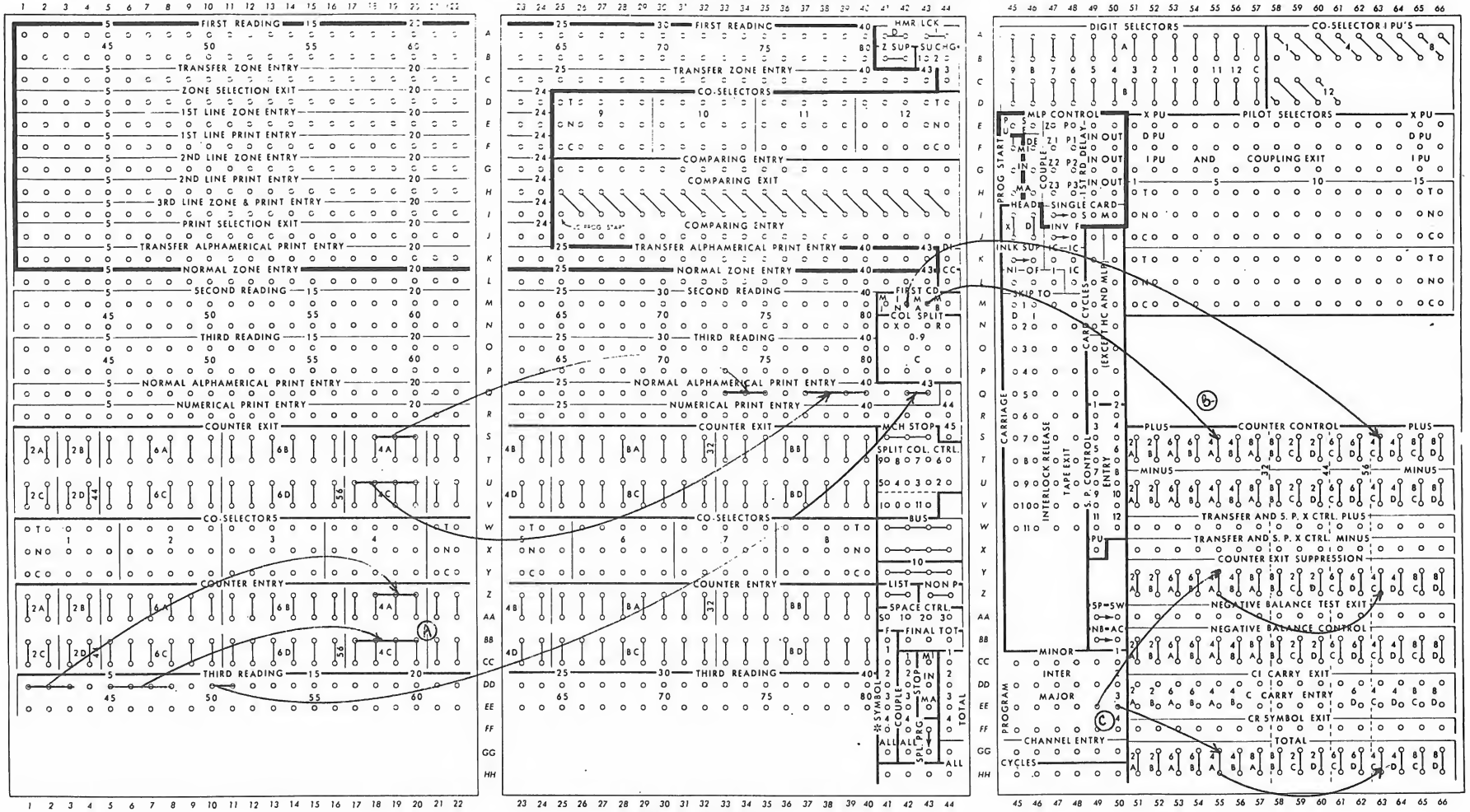


Figure 10.

entry will come out of the exit hubs, unless counter exit suppression is wired.

We are going to impulse our counters to add using hubs labelled "First Cd." There are three first cd. hubs which are of interest to us, (M, 41-43). Mi. first cd. emits an impulse for the first card of each minor control group; in. first cd. emits an impulse for the first card of every intermediate control group; and ma. first cd. emits an impulse for the first card of every major control group. Remember, that every time we have a major program cycle taken, both intermediate and minor program cycles are also taken. For the first card of each major control group, all three first card hubs emit. Also, for each intermediate control program, a minor program is taken; therefore, for the first card of each intermediate control group, both minor and int. first card hubs will emit.

We impulse our counters to add using the first card impulse. Counter 4A is impulsed to add with major first card - the field store number which is our major control group will enter the counter entry hubs of 4A and come out of the exit hubs just once, when that counter is told to add - for the first card of each major control group. The Intermediate first card impulse is wired to the plus hub of counter 4C to enable our intermediate indicative field (dept. no.) to print on the first line of each intermediate group.

Our minor control group will print all the time as it is wired normally.

C. Both counters are cleared at major time. Since we do not want the information which is in the counter to print at the time it clears, they are both suppressed.

EXERCISE 2.

Diagram the required control panel on the blank sheets provided. The correct solution will be found in the back of this lesson.

The report required is the one shown in Figure 11. This is a tabulation of amounts receivable by account within Branch Office. The following cards are used in the report:

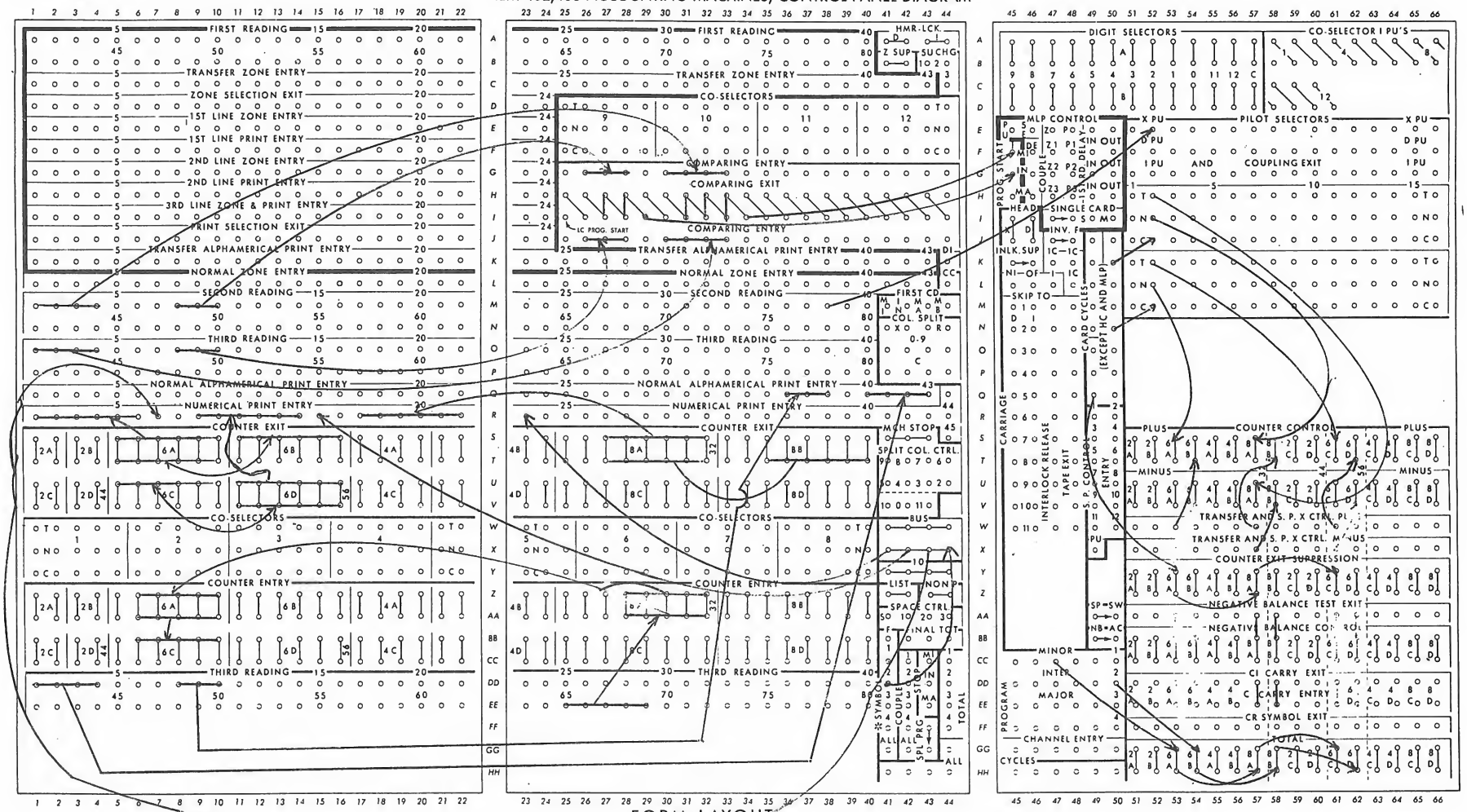
Field	Card col.
Branch Office	1-3 (intermediate control group)
Acct. No.	8-11 (minor control group)
Amount	20-25) (credits have an X in c.c. 40)

Use counter 8A for accumulating amounts for each account. Print the total in numeric t.b. 2-9. Use counter 8C for accumulating amounts for each branch. Print these totals in numeric t.b. 12-19. Accumulate a final total of all cards in accumulator 8B and print directly under the intermediate totals.

Branch Office	Acct. No.	Amount	Total by Branch
346	1456	117689	
	2345	1045075	
	4356	456000CR	
	4535	150900	
	5676	4350CR	
			1263714
450	789	15000	
	1324	2025CR	
	2356	18000CR	
			5025CR
			1258689 *

Figure 11.

Solution to Exercise 1.



Solution to Exercise 2.

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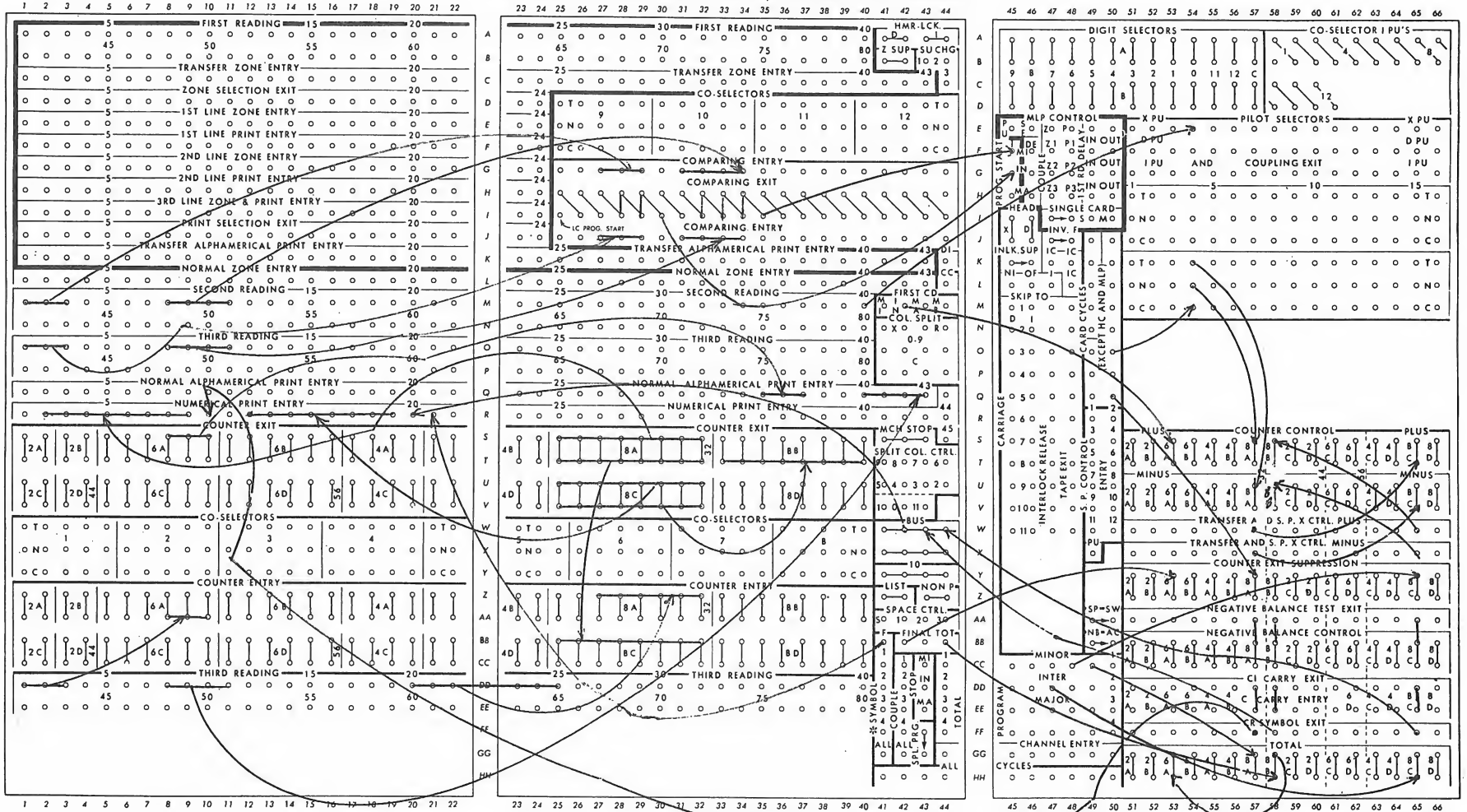
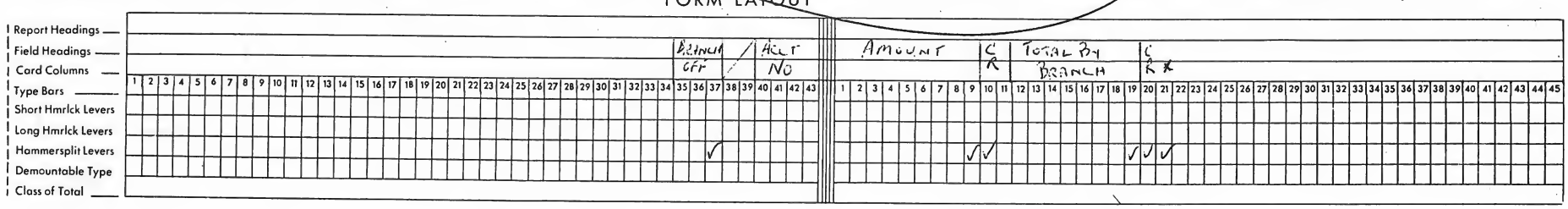


FORM LAYOUT



We are to prepare the report illustrated in Figure 12. Card columns, typebars, and counters to be used are indicated on the report. Answer the following questions True or False. If True, mark an X in Box A; if False, Mark an X in Box B.

Store	Dept.	Item	Total Sold	Total Returned	Net Sales
12	145	3456R	56	4	52
		4550T	187	23	164
		5666B	7	11	4CR
			250*	38*	212 *
	335	5666B	28		28
			28*		28 *
24	100	1111A	650	32	618
		1234W	34	3	31
		1654	109	5	104
			793*	40*	753 *
c.c. 5-6	7-9	11-15	17-19	17-19	17-19
ctr. 4A	4B		6A Mi	6C Mi	8A Mi
			6B Int	6D Int	8B Int
		Returns have an X in c.c. 68			
Typebars					
A, 32-3	A, 35-7	A, 39-43	N, 1-6	9-14	16-21
Major	Int.	Minor			

Figure 12.

1. This is a tabulated report.

2. This report has been prepared using the counter method of group indication.

3. Counters 4A and 4B would be suppressed with a card cycles impulse.

4. Counters 6A, 6C and 8A would be suppressed with a card cycles impulse.

5. Counter 6A exit hubs would be wired to the exit hubs of counter 6B.

6. The plus hub of counter 6B would be impulsed from the Transfer & S.P.X. Ctrl Plus hub of ctr. 6A.

7. Counter 4A would be impulsed to add from card cycles.

8. Counter 6A would add NX 68 cards.

9. It would be necessary to wire counters 6A and 6C to subtract.

10. Counter 8A would add NX 68 cards and subtract X68 cards.

11. Item number would be considered an alphabetic field.

12. c.c. 15 would be wired from second reading into a bus hub and from two of the common bus hubs to (1) a comparing magnet, and (2) normal zone entry 43.

13. c.c. 17-19 would be wired to the counter entries of 6A, 6B, 6C, 6D, 8A and 8B.

14. The asterisk symbols would have to be wired through a set of bus hubs.

15. The CR symbol would print in the proper place if it were wired from the CR symbol exit of ctr. 8A to numeric t.b. 22. Assume here that intermediate totals can never be negative.

16. Ctr. 4B would be impulsed to add from intermediate first card.

17. Assume that counters 4A and 4B are cleared with a major program exit impulse. They would also be suppressed at the same time with a card cycyles impulses.

18. The pilot selector required in this problem would be picked up by wiring from c.c. 68, third reading to the XPU hub of the selector.

19. The following hammersplits would be raised: Alpha. 33, 37; numeric 6, 7, 14, 15, 21, 22, 23.

20. It is possible to initiate a major program even though we are not accumulating any major totals.

I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING

LESSON #18

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18.1 USE OF CO-SELECTORS

The 402 tabulator has eight standard five-position co-selectors, W-Y, 1-40 and four optional five-position co-selectors, D-F, 25-44. The selector pick-up hubs are to be found on the diagram at A-B, 58-66 and C-D, 58-61. Each co-selector has two common, diagonally arranged pick-up hubs. The use of these pick-up hubs will be explained in our first problem.

When a co-selector pick-up hub receives an impulse it transfers all five positions of that co-selector immediately for the balance of that machine cycle. The co-selector drops out at the end of that machine cycle.

The two basic co-selector functions are: (1) field selection - taking one or more fields to the same place; (2) class selection - taking one field to more than one place. We covered both these concepts in our discussion of the interpreter, but we will cover them again here.

PROBLEM: A company has two offices, a main office in New York City and a branch office in San Francisco. Sales slips are punched into IBM cards at each office and then the San Francisco office sends its cards to New York City. In New York City, the IBM department has punched its sales cards in the following format:

Field	Card cols.
Item No.	10-13
Amount of Sale	25-30

When the cards from San Francisco come in, they are examined and found to contain the following fields:

Field	Card cols.
Item No.	10-13
Amount of Sale	34-39

We are required to prepare the report shown in Figure 1. Now we could take either group of cards, the group punched in New York or the group punched in San Francisco, and we could reproduce them so that the fields in each were identical.

This would mean that we would waste all of our original deck from one of the cities and IBM cards are expensive. We decide to punch a distinguishing X in c.c. 79 of the San Francisco cards. We then sort all our cards into sequence by item number, c.c. 10-13.

Figure 2 is the required control panel diagram.

Notes on Figure 2:

A. Item number is wired as our minor control group. The LC Prog. Start hub is wired to Int. Prog. Start. This hub emits an impulse after the last card has passed third reading.

B. Our indicative field, item number, is wired to num. t.b. 1-4.

Item No.	New York Sales	San Fran. Sales	Total Sales
1657	176850	35025	211875
2356	19000	120000	139000
3456	689050	6000	695050
3588	45120	56025	101145
	930020*	217050*	1147070*

Figure 1.

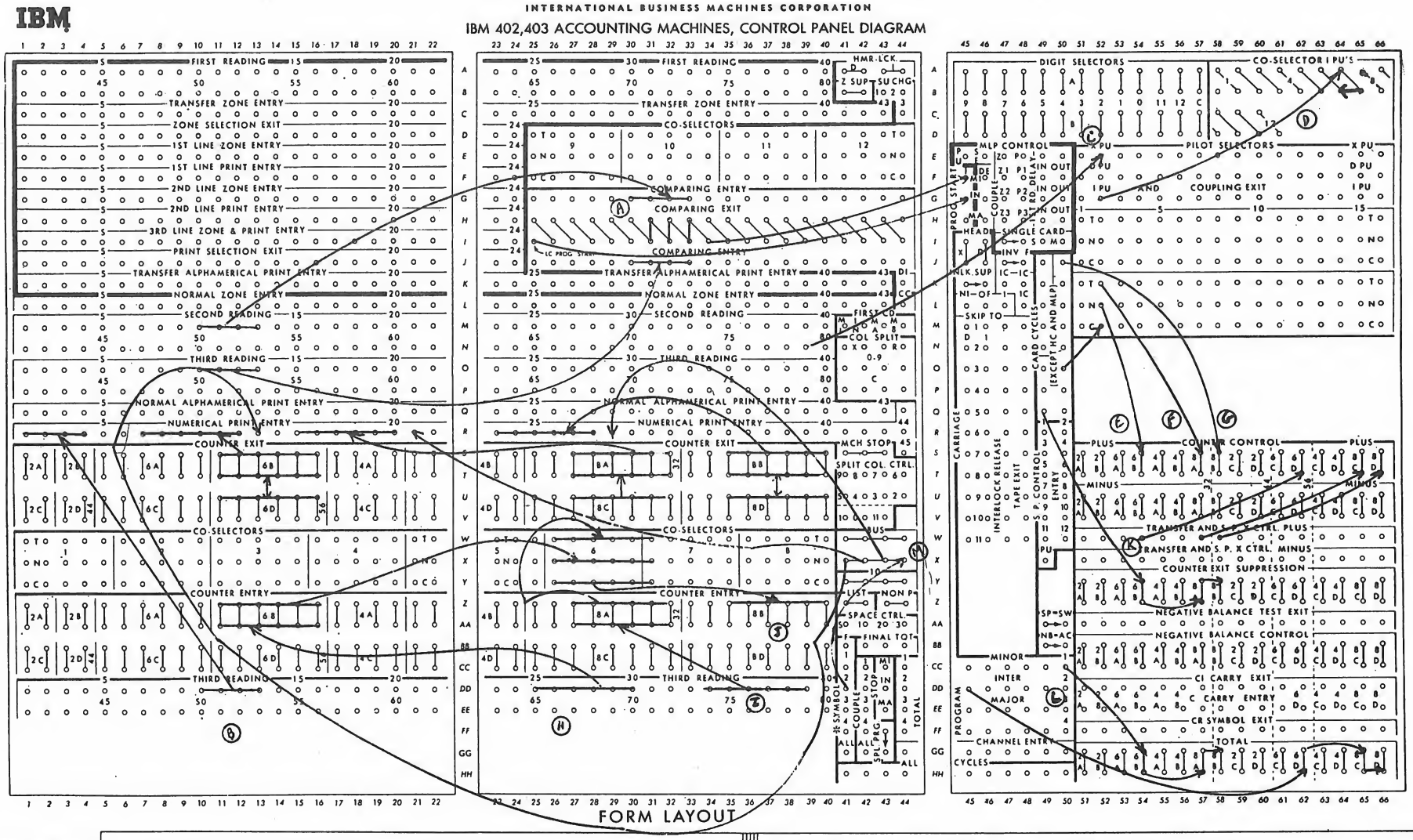
IBM
INTERNATIONAL BUSINESS MACHINES CORPORATION
IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM
FORM LAYOUT
Report Headings
Field Headings
Cord Columns
Type Bars
Short Hmrlck Levers
Long Hmrlck Levers
Hommersplit Levers
Demountable Type
Closs of Total
ITEM NO
N.Y. Sales
San Fran Sales
Total Sales

Figure 2.

C. Our pilot selector is picked up by cards that have an X in c.c. 79. Our general rule is that a pilot selector's XPU hub will accept an "X" or "12" impulse and transfer the selector on the next card cycle. As the selector transfers, it emits an impulse from its IPU hub. Note here that the IPU hub serves a dual purpose. As an input hub, it accepts any impulse to transfer the selector immediately. As an exit hub, it emits an impulse which is used to transfer other pilot or co-selectors. In this instance, it is used to couple the pilot selector with co-selectors 6 & 7. It could also be used to couple this pilot selector with other pilot selectors.

D. Co-selector 6, and through its common pick-up hub, co-selector 7 are both transferred at the same time that the pilot selector transfers. The IPU hub of pilot selector 2 will emit an impulse at the time pilot selector 2 transfers - this impulse, when directed into the IPU hub of a co-selector, transfers that co-selector immediately. At the time that X79 cards are passing third reading, pilot selector 2 and co-selectors 6&7 are all in a transferred condition.

E. Counter 6B is impulsed to add NX 79 (New York) cards only.

F. Counter 8A is impulsed to add X 79 (San Francisco) cards only.

G. Counter 8B is impulsed to add all cards.

H. Card cols. 25-30 are wired to counter entry of 6B and from the common counter entry hubs to the normal hubs of co-selectors 6&7. Counter 6B therefore will add c.c. 25-30 from NX 79 cards (this is the New York counter).

I. Counter 8A entry hubs have c.c. 34-39 wired to them and from the common entry hubs to the transferred hubs of co-selectors 6&7. Counter 8A therefore will add c.c. 34-39 from X 79 cards only (this is the San Francisco counter).

J. Counter 8B is wired to add all cards. At the time a NX 79 card is passing third reading, co-selectors 6&7 are normal. Therefore, the information entering the normal hubs of co-selectors 6&7 will come out of the common hubs to enter the counter entry hubs of 8B; at the time an X79 card is passing third reading the information entering the transferred hubs of co-selectors 6&7 will come out of the common hubs to enter 8B. You will see here that 8B will add c.c. 25-30 from NX 79 cards and add 34-39 from X79 cards. This is exactly what we want.

K. Our intermediate total counters will add when our minor total counters clear. Since both totals are printing from the same typebars, we wire from counter exit to counter exit.

L. Our counters are cleared.

M. The asterisks are wired through a set of bus hubs.

This problem illustrates the principles of field selection. Two different fields (c.c. 25-30 and 34-39) are taken to the same place (counter entry of 8B).

Figure 3 illustrates a class selection problem and Figure 4 the solution.

The facts are as follows: all cards contain a field employee number in c.c. 9-12 and a total earnings field in c.c. 65-71. Should the total in the total earnings field be greater than $4200.00, that card also contains a digit 4 in c.c. 80. We are to list all cards, print-

Empl. No.	Earnings under 4200	Tot. No.	Earnings over 4200	Tot. No.
67	324500			
68	345700			
156			435650	
167	145680			
188	35000			
345			650000	
478			1050000	
678	65700			
1456			430000	
1457	250000			
2456	340000			
3456	180000			
4560			560000	
4565	240000			
4687	6500			
		10		5

Figure 3.

ing those employees who have earned exactly $4200.00 or less in one set of typebars; those employees who have earned in excess of $4200.00 will be printed in another set of typebars. At the end of the job we will print totals of how many employees are in each category.

Notes on Figure 4:

A. All cycles is wired to List, and our employee number is wired to the typebars.

B. Our LC hub is wired to initiate a minor program.

C. Second reading c.c. 80 is wired to the common hub of digit selector 1. Should a card contain a "4" in c.c. 80 (over 4200.00), this impulse will pick-up pilot selector 6. All other cards would be blank in c.c. 80.

D. At the time pilot selector 6 transfers, it will cause co-selectors 1&2 to transfer.

E. The CC hub (digit 1) is wired to counter entry of 4A and 4B.

F. Counter 4A is impulsed to add only (No 4) cards (equal or under 4200.00); counter 4B is impulsed to add those cards which have a 4 (over 4200.00). Both counters are suppressed as we are interested only in their totals.

G. Both counters are cleared at minor time.

H. Card cols. 65-71 are wired to the common hubs of co-selectors 1&2. At the time (No 4) cards are passing third reading, these co-selectors are normal and this field will come out of the normal hubs to alpha t.b. 7-13. At the time those cards which contain a 4 in c.c. 80 are passing third reading, the co-selectors will be transferred and the earnings field which has entered the common hubs will come out of the transferred hubs to alpha t.b. 21-27.

Selectors, as we well know, act as switches. They permit us to divert the path of an impulse or the path of a field depending upon the presence or absence of control punches. They provide us with the flexibility needed to process different card formats at the same time.

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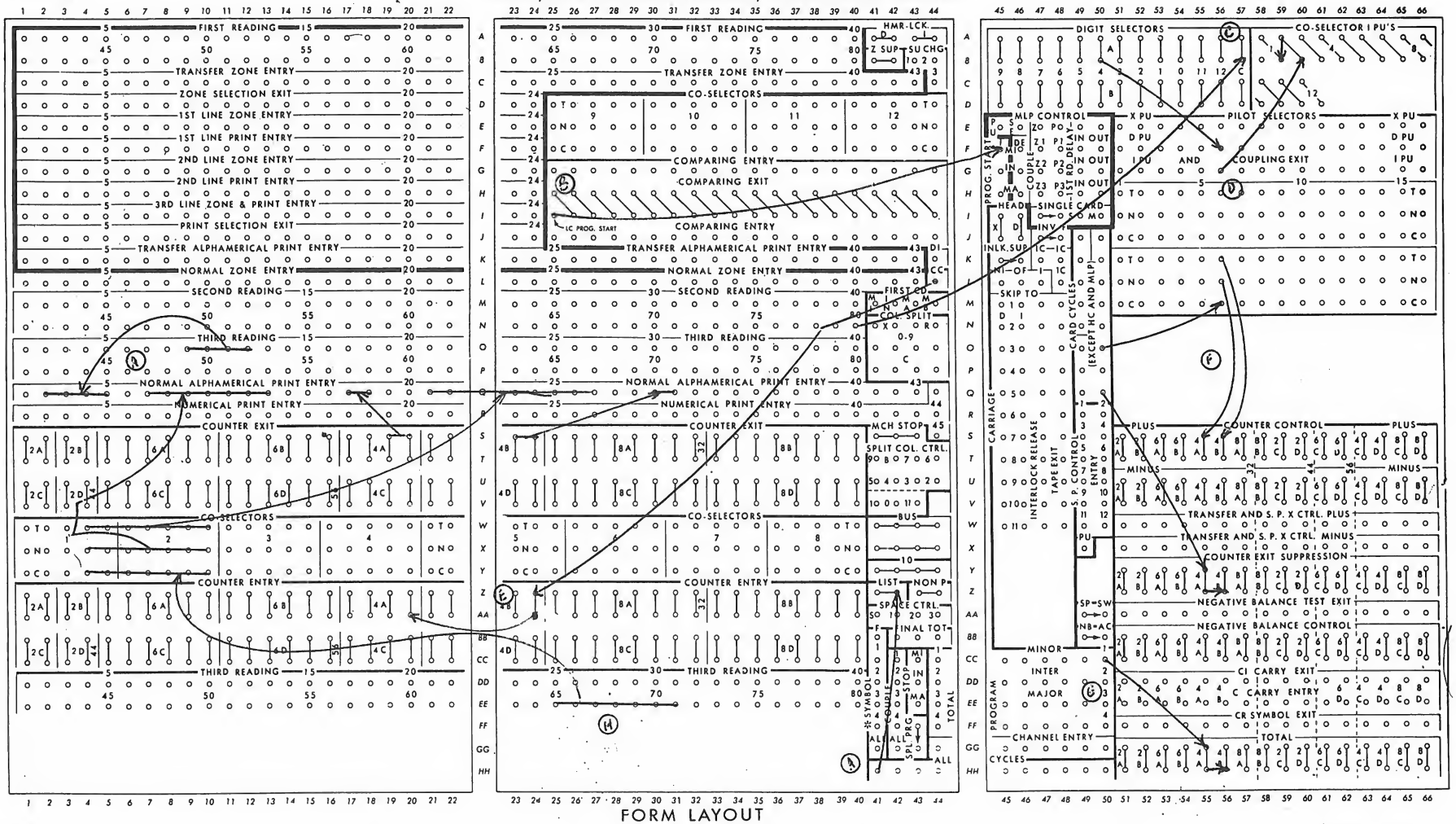
IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM



FORM LAYOUT

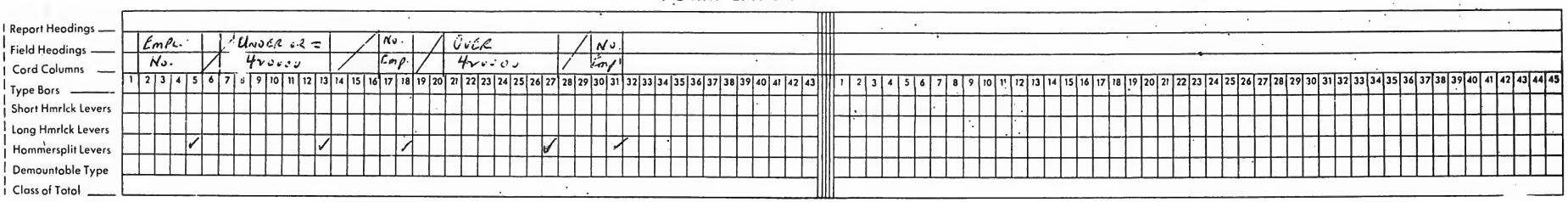


Figure 4.

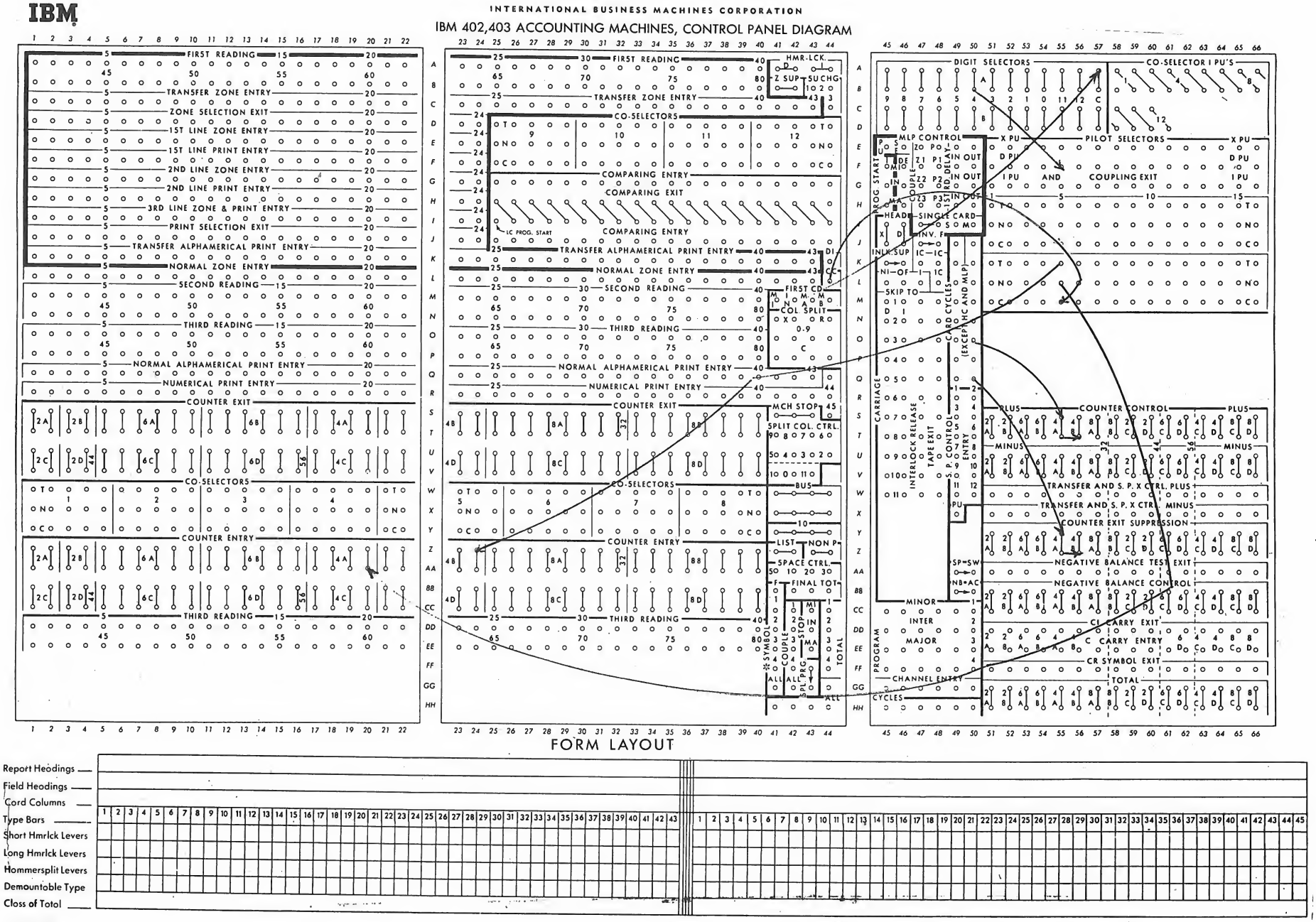


Figure 5.

FORM LAYOUT

Another method of wiring counters 4A and 4B is shown in Figure 5. In this illustration, we are selecting the card count impulse and adding all cards. In Figure 4, we select the add impulse and permit the card count impulse to enter both counters all the time. Remember that important principle of addition or subtraction. Counters add or subtract only when two conditions are satisfied: (1) information enters the counter and (2) the counter receives an impulse to add or subtract.

Let us try a couple of exercises:

EXERCISE 1.

Prepare the required control panel diagram for the report illustrated in Figure 6.

There are two types of cards used in this report:

1. Sales cards which are punched according to the following format:

Field	Card col.
Item No.	3-6
Description	10-18
Quantity Sold	22-25

2. Return cards which are punched according to the following format:

Field	Card col.
Item No.	3-6
Description	10-18
Quantity Ret.	30-33
Control X	39

Item No.	Description	Sales	Returns	Net Sales
1345	Chair	657	23	634
1478	Sofa	65	9	54
2300	Lounge		3	3CR
2356	Lounge	460		460
3456	End table	34	1	33
4990	Corner	1450	56	1394
t.b. A, 30-33	A, 35-43	N, 1-6	N, 8-13	N, 16-21

Figure 6.

Note that quantity is punched in different fields in each card. Use counter 6A to accumulate sales; 6B for returns and 8A for net sales (sales less returns). The typebars to be used are indicated on the report. This is a tabulation.

The student is left with the choice of required selectors. Although they may not agree with those used in the school solution, the theory behind their use should agree. In other words, the quantity of selector positions used and method of pick-up should agree.

A school solution for this exercise will be found in the back of this lesson.

EXERCISE 2.

A company has an accounts receivable file which indicates the amount of money owed to

it. There are two types of cards in this file: (1) cards which represent amounts due the company for retail sales; (2) cards which represent amounts due the company from sales to wholesalers (these cards have an X in c.c. 75). The balance of the card format is indicated below:

Field	Card col.
Acct. No.	8-11
Amount of Sale	15-21

We are to prepare a report such as the one illustrated in Figure 7. This is a listed report with a total for the entire run. Use counter 8D for the total sales amount.

Acct. No.	Retail Sales	Wholesale Sales	Total Sales
1457	67890		67890
2390	150000		150000
3478		600000	600000
3488	500		500
4354		420000	420000
5465		150000	150000
			1388390*
t.b. N, 1-4	7-13	15-21	23-30

Figure 7.

18.2 GROUP INDICATION USING CO-SELECTORS

In the last lesson we discussed the counter-method of group indication. Group indication, you recall, is used to print information from the first card of a group only. In other words, we prevent the printing of repetitive information which only clutters up our reports.

Let us take one of the problems used in lesson 17 and discuss how the group indication part of it would be solved using selectors rather than counters. The report to be prepared is shown below in Figure 8. Figure 9

Store No.	Dept. No.	Sls. No.	Sales by salesman	Sales by Dept.	Sales by Store
12	145	16	24500		
		23	5690		
				30190	
	256	65	56055		
		67	2500		
		87	10020		
				68575	
					98765
23	100	11	16710		
		54	2800		
				19500	
					19500

Figure 8.

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IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM

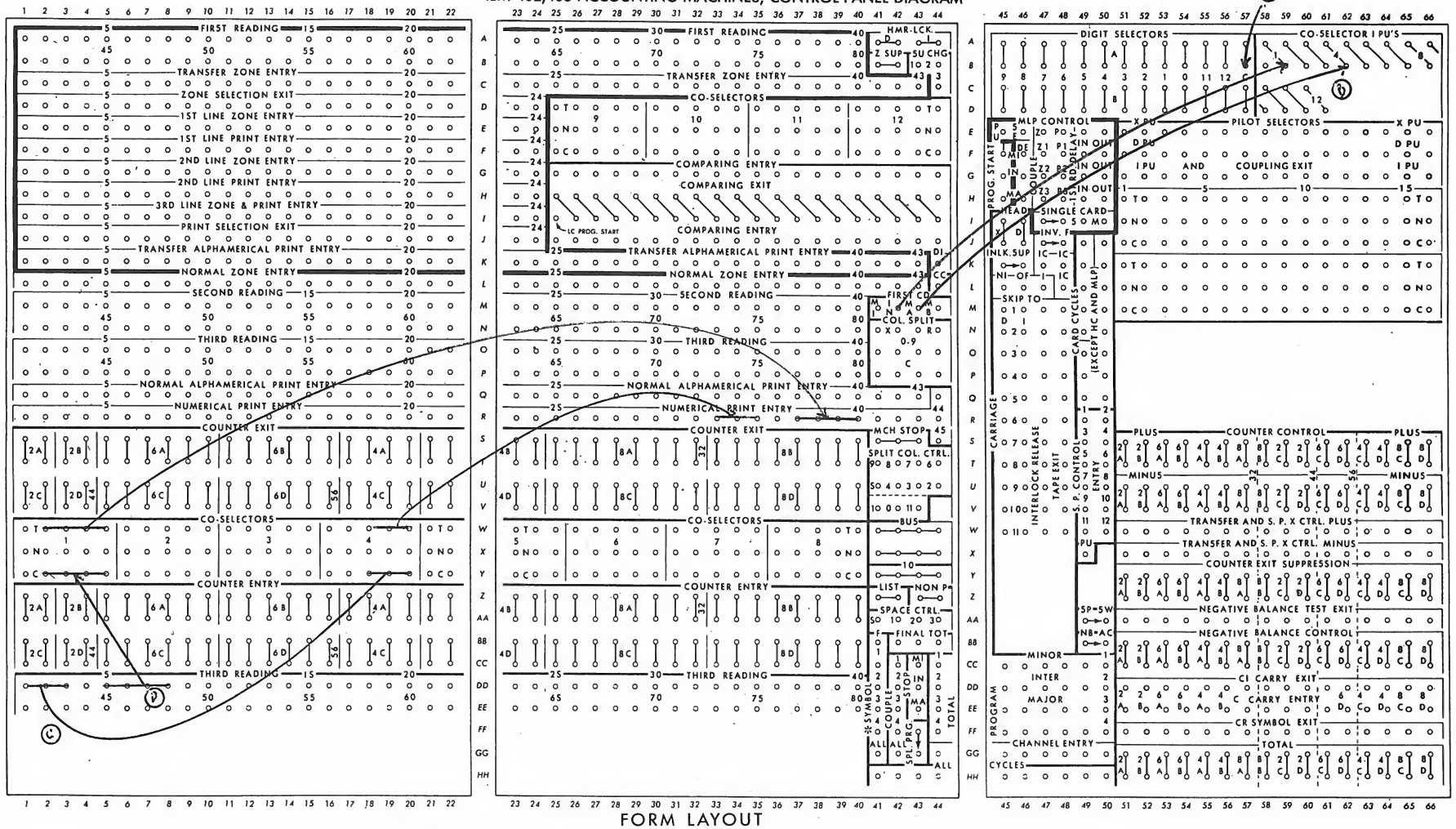
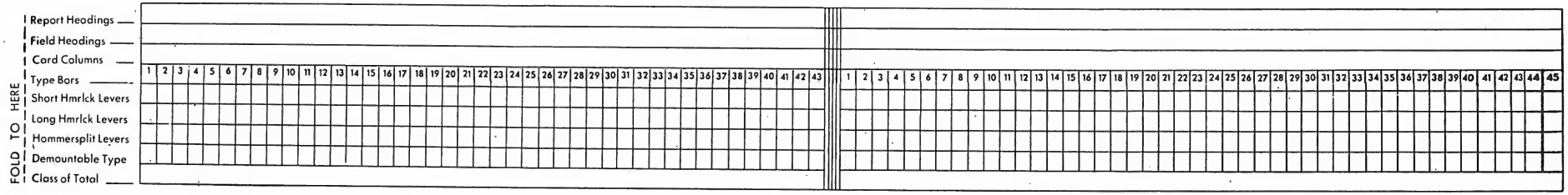


Figure 9.

FORM LAYOUT



is the control panel diagram required to solve this problem. Only the group indication portion has been shown.

Notes on Figure 9:

A. Co-selector 1 is picked-up immediately by the impulse Int. first card. This selector will be in a transferred condition as the first card of each intermediate group is passing third reading.

B. Co-selector 4 is picked-up by the impulse major first card. This selector will be in a transferred condition as the first card of each major group is passing third reading.

C. Our major indicative field, c.c. 1-3 is wired into the common hubs of co-selector 4. It will be available from the transferred hubs to print only when the selector has been picked-up - for the first card of each major group.

D. Our intermediate field, c.c. 5-8 is wired to the common hubs of co-selector 1. It will be available from the transferred hubs of this selector only when it is picked-up - for the first card of each intermediate group.

Either the counter or selector method of group indication can be used in a problem, or both can be combined. The choice usually depends on which component in the machine is more readily available, (not required for other parts of the problem).

18.3 SUMMARY PUNCHING

The primary purpose of the 402 tabulator, and for that matter, of all IBM machines, is to collect, assemble and prepare data for the use of those people in a company who are responsible for its management.

Many of the figures accumulated in the 402 while it is preparing a report are figures which may have some future use in other reports. It is important that we preserve these figures, not only on the report, but also in punched card form. The technique used to cause information which has been accumulated in the 402 to be punched into cards is called summary punching.

It is possible to connect our 514 Reproducer to our 402 accounting machine. This is done by means of a cable which is part of the 514 and which is attached to the summary punch receptacle of the 402. See Figure 10.

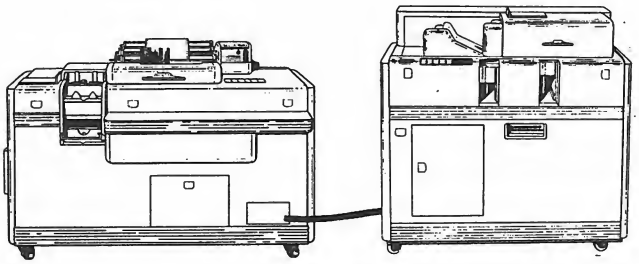


Figure 10.

In summary punching, we are going to be concerned with two control panels: one for the 402, and one for our reproducer.

Let us examine those features of the reproducer control panel which are used in summary punching. See Figure 11.

The hubs AA, AB, AE, AF, 1-20 are exit hubs which correspond to our counter exit hubs. Impulses from these hubs are wired to specified punch magnets to cause information being accumulated in our 402 counters to be punched in those columns we select. Note that these hubs are entries to the comparing magnets for other reproducer operations.

Information which is to be summarized must first be placed in a 402 counter. Normally, we think of summarizing numerical information only. An optional device must be installed in the 402 to permit alphabetical data to be summarized.

Normally, we will summarize two types of data: (1) accumulated amounts which by

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513—514 AUTOMATIC REPRODUCING PUNCH, CONTROL PANEL

FOR SUMMARY PUNCHING—ALPHABETIC ACCOUNTING MACHINE

Form X24-9188-9
Printed in U.S.A.

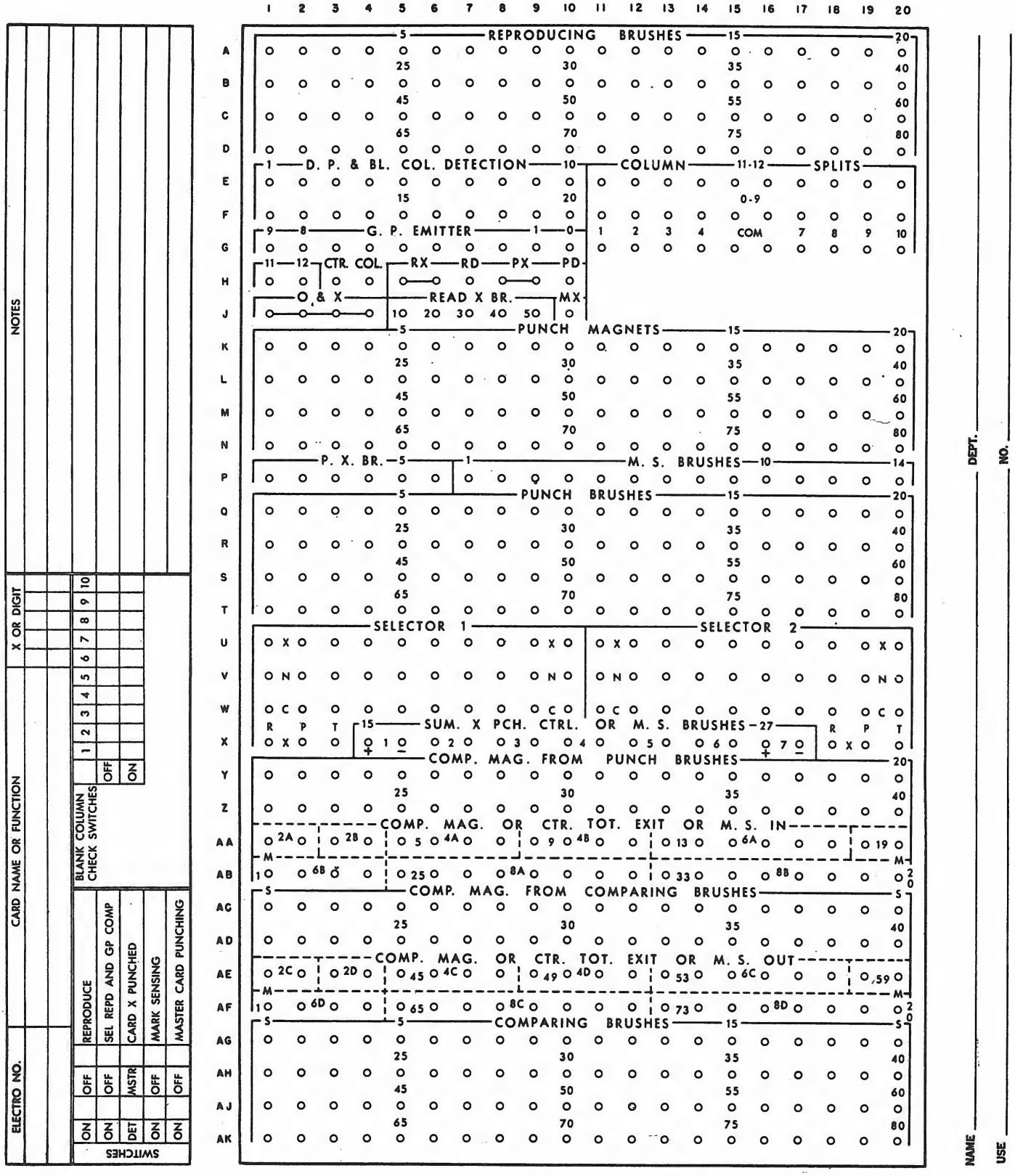


Figure 11.

their nature will be in counters; (2) indicative information used to identify our cards and amounts. This type of information is not normally placed in counters but can be so placed as our examples will indicate.

Sls. No.	Amount of Sales
6	67895
8	156000
12	45000
24	30000CR
36	240000
56	6000
	484895 *

Figure 12.

Let us take a simple problem to illustrate summary punching:

We are going to prepare a tabulated report such as the one shown in Figure 12. This is a tabulation of sales by salesman. The fields and card columns are indicated below:

Field	Card col.
Sls. No.	5-6
Amount of Sale	20-25 (credits are punched with an X65)

Our summary cards are to be punched as follows:

Field	Card col.
Sls. No.	5-6
Amount of Sale	18-25 (negative totals identified with an X65). All summary cards to be punched with an X78.

The 402 control panel diagram required is illustrated in Figure 13. The 514 summary panel required is shown in Figure 14.

Notes on Figure 13:

A. The salesman's number field is wired to the comparing magnets to set up our minor control. Last card is wired to intermediate program start.

B. Salesman number must be summarized. Information which is to be summarized must be in a counter. Therefore, we wire salesman number to counter entry of 2D.

C. Counter 2D is impulsed to add with a minor first card impulse. The counter will add the salesman number once for each salesman. Also, at the time it adds, the salesman number will come out of the counter's exit hubs to print in alpha. t.b. 42-3.

D. Our amount field enters counter 8C.

E. Our pilot selector has been picked-up by an X in c.c. 65 from second reading. Counter 8C is impulsed to add NX65 cards and subtract X65 cards. Since this is a tabulation, 8C is suppressed and our neg. bal. test exit is wired to neg. bal. ctrl., and CI is wired to C.

F. When 8C clears at minor time, its totals are transferred to the intermediate counter 8A.

G. Since both classes of totals are printing in the same typebars, 8C totals are wired to 8A exit hubs.

H. Our counters are cleared.

I. Our summary punch control pickup hub (X, 49) is impulsed from minor program exit since we desire to summarize minor totals.

J. Should our minor total be negative, the transfer and S.P. ctrl. minus hub of 8C will emit. This impulse is taken

IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM

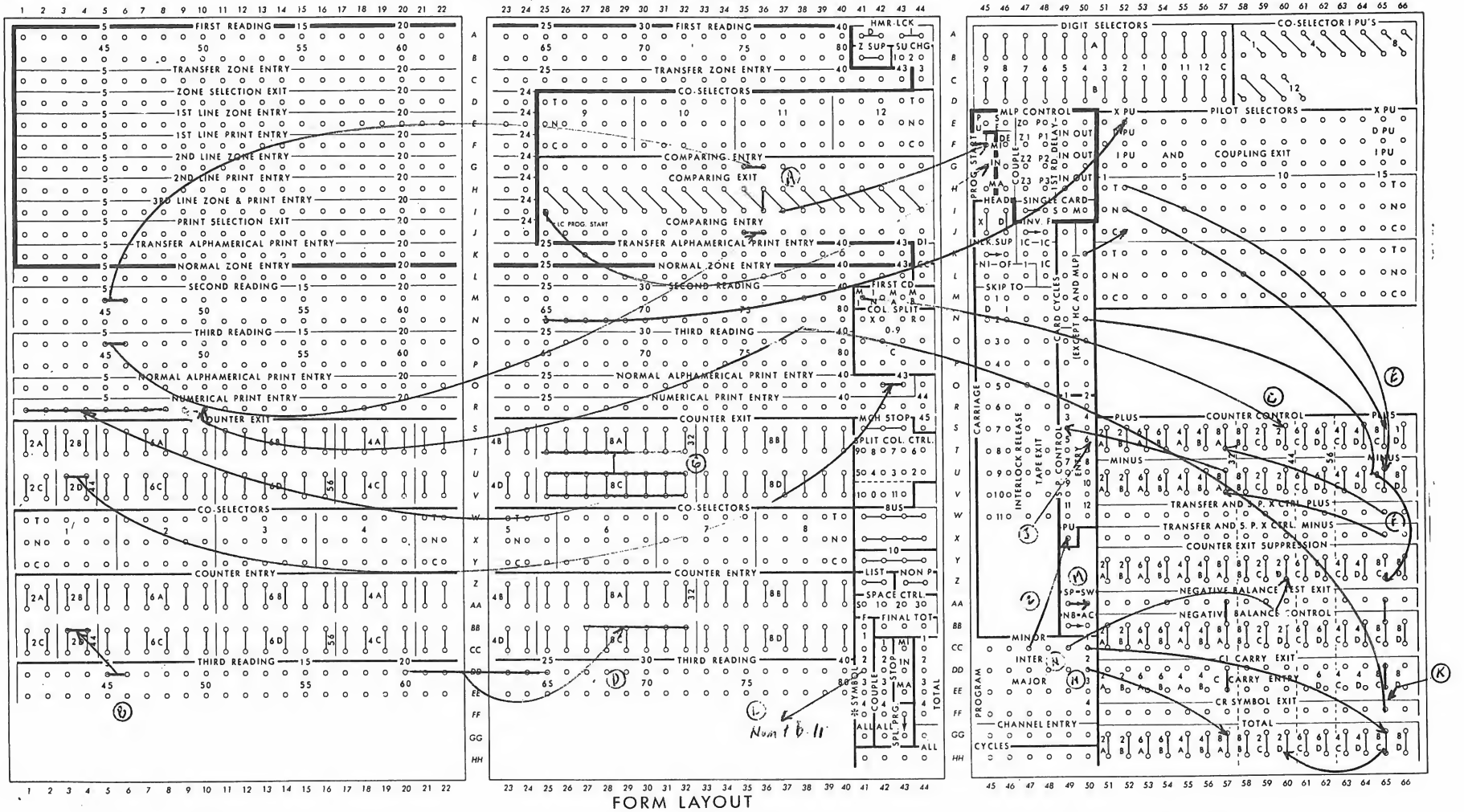
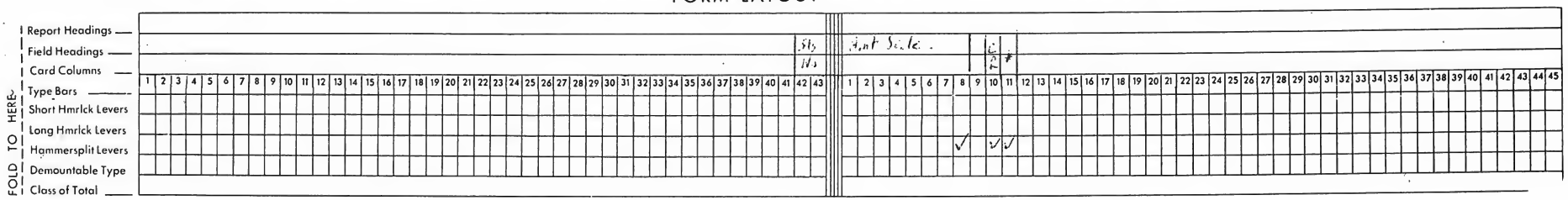


Figure 13.

FORM LAYOUT



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513—514 AUTOMATIC REPRODUCING PUNCH, CONTROL PANEL

FOR SUMMARY PUNCHING—ALPHABETIC ACCOUNTING MACHINE

Form X24-9188-9
Printed in U.S.A.

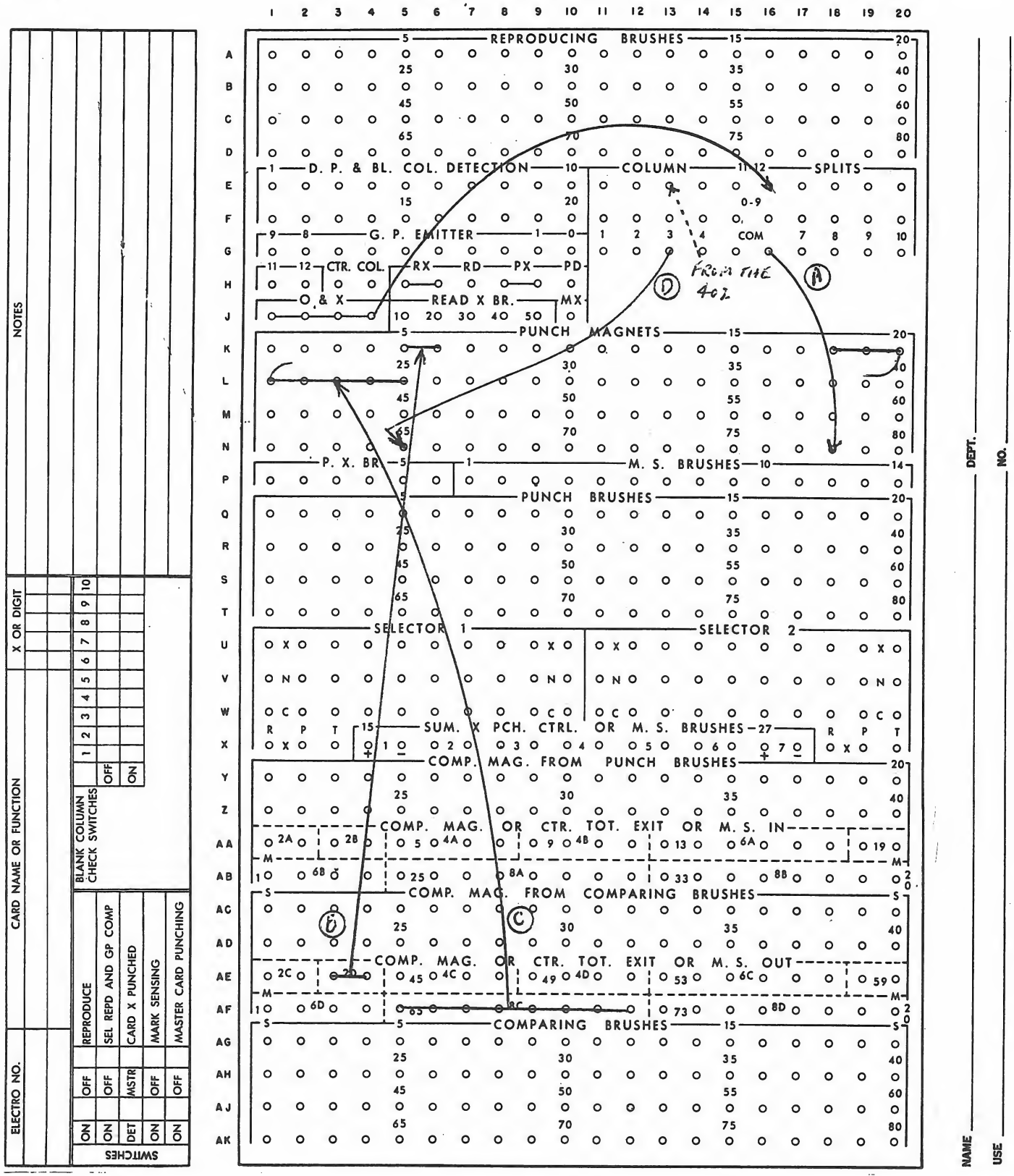

Figure 14.

to the minus hub of 8A, and from the common minus hub of 8A enters S. P. Control hub 3. This latter hub is internally connected to the 11-12 hub of the correspondingly numbered column split on the 514 reproducer panel.

K. Should our minor totals be negative a CR symbol will print in numeric t. b. 10. The problem assumes that intermediate totals will always be positive.

L. Our intermediate asterisk is wired to num. t. b. 11.

M. To activate the 514, our summary punch switch (AA, 49-50) is wired on.

N. Ctr. 2D is suppressed at minor time. Its contents will still be punched.

Every time the 402 prints a minor total, the 514 reproducer will be told to punch a card which will contain the figures standing in the 402's counters at that time. Let us look and see how the reproducer panel is wired.

Notes on Figure 14:

A. We emit an X78 through our column split to identify this card as a summary card.

B. Salesman Number which had been added in ctr. 2D is wired to punch in c. c. 5-6.

C. Our amount accumulator is wired to c. c. 18-25

D. Our transfer and S. P. ctrl. minus hub of 8C had been wired to the "3" S. P. Control hub on the 402 panel. This hub is internally connected to the 11-12 hub of column split 3 on the reproducer panel. In other words, an "x" impulse is being emitted into the 11-12 hub of column split 3 by the 402. This impulse is wired to c. c. 65 to punch an X to identify this total as a negative total.

The result of this summary punching operation is that we get a single card for each salesman which has in it his number and his total sales for the period.

EXERCISE 3.

Diagram the required 402 and 514 control panels to produce the report illustrated in Figure 15 and summarize a card for each

Item No.	Old Balance	Receipts	Requisitions	New Balance
1657	680	40	60	660
2345	457	187	122	522
3454	1000		650	350
4355	8CR	20		12
6570	24	16	42	2CR
8889	65			65
ctr: 4A T.B. num. 1-4	6A 6-11	6C 15-20	6D 22-27	8D 30-35
	Add or subt. type 1	Add type 2	Add type 3	Add or subt. type 1; add type 2; subt. type 3.

Figure 15.

item containing the item number and new balance.

Three types of cards are used in this report. Their fields and card columns are indicated below:

Type 1 - Old balance (this is the summary card produced the last time this report was run).

Field	Card cols.
Item No.	15-18
Quantity	65-70 (minus quantity cards have an X75)

All these cards have an X40.

Type 2 - Receipts (represents merchandise received during the period).

Field	Card cols.
Item No.	15-18
Quantity	30-34

Type 3 - Requisitions (represents merchandise withdrawn from stock during the period).

Field	Card cols.
Item No.	15-18
Quantity	30-34

All requisition cards have an X35.

The new balance summary cards are to be punched in the same fields as type 1 cards. The next time this report is run, the summary cards being punched now will become the old balance cards of the next report.

Figure 15 indicates the counters and typebars to be used and an indication of what each counter is to add.

Note that in all problems, we must assume that card columns which are not used in the problem may contain information of one kind or another. In other words, do not assume that the balance of a card is blank.

This exercise covers our principles of multiple X selection and the use of co-selectors.

18.4 RUNOUT BUTTONS AND SWITCHES

These four buttons and switches are found on the left hand side of the machine immediately above the control panel, (Figure 16). Their use is described below.

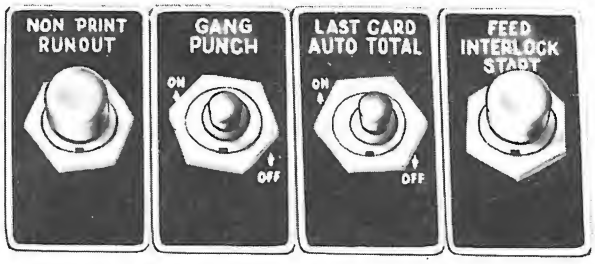

Figure 16.

Feed Interlock Start - should the machine fail to feed a card, it will stop and the card feed light will go on. It must be restarted by pressing the feed interlock button to run all cards out of the machine. The last card that runs into the stacker is placed in front of the remaining cards in the hopper and the machine is re-started by again pressing the feed interlock button. Should the machine fail to feed, the start button is inactivated and the procedure outlined above must be followed.

Last Card Auto Total - when this switch is turned on, it inactivates all comparing exits. Any minor, intermediate or major program starts which are wired are ignored by the machine. The machine does cause a major program to be forced on both the run in (first card) and run out (last card) of a job.

Gang Punch - when this switch is turned on, a reproducing punch which is connected to the 402 by means of the summary punch cable, can be used independently of the tabulator.

Non Print Runout - when this button is depressed, cards run out of the machine without being processed. No printing will occur.

18.5 SETUP CHANGE SWITCHES

These three switches, Figure 17, are also found on the left hand side of the machine. They permit changes to be made in the control panel without the necessity of actually changing any wires in the panel.

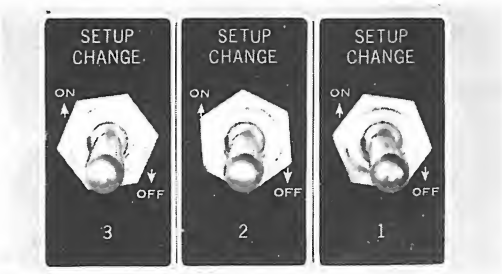

Figure 17.

Each setup switch when placed in an ON position causes its correspondingly numbered hub on the panel (B, 43-44; C, 44) to emit an impulse which can be used to pickup a selector.

Figure 18 illustrates how the 402 will be in a summary punching status when setup change switch one is ON; it will not summary punch when this switch is OFF. It will be in a tabulating status when setup switch two is ON; it will be in a list status when setup switch two is OFF.

Notes on Figure 18:

A. When setup change switches one and two are ON, they will pickup pilot selectors 3 and 11 immediately for every machine cycle.

B. To activate the summary punch, selector 3 must be transferred. It will be transferred should setup change switch one be ON.

C. If setup switch 2 is ON, selector 11 will be transferred, counter 8C will be suppressed and All Cycles will not reach the List hub. The 402 will then tabulate. When this setup switch is OFF, the machine will be in a list status with c.c. 10-13 group indicating.

18.6 EXPANDING COUNTERS

There are many situations when we desire to accumulate totals which are larger in size than any single available counter. For example, assume that we are to accumulate a total which we estimate may be ten digits long. Our largest available counter is an 8-position counter. We would have to couple (connect) two counters together so that they act as one. We can couple as many counters together as we wish, provided that the counter created from this coupling does not exceed 16 positions in length. Figure 19 illustrates a report we desire to prepare. This report includes total fields which are larger than any single available counter - we will therefore couple counters together. Also notice that our intermediate and major totals print on the same line as our minor totals, that a double space has been taken after an intermediate total and a triple space after a major total. The required wiring to accomplish variable spacing such as this will be discussed. The fields in our cards are as follows:

Field	Card cols.
Store No.	1-2 (Major)
Dept. No.	3-5 (Int.)
Salesman No.	8-10 (Minor)
Amount of Sale	15-20 (returns have an X32)

The required control panel diagram is shown in Figure 20.

Notes on Figure 20:

A. Information enters our minor counter 6B from third reading. Counter 6B is

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IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM

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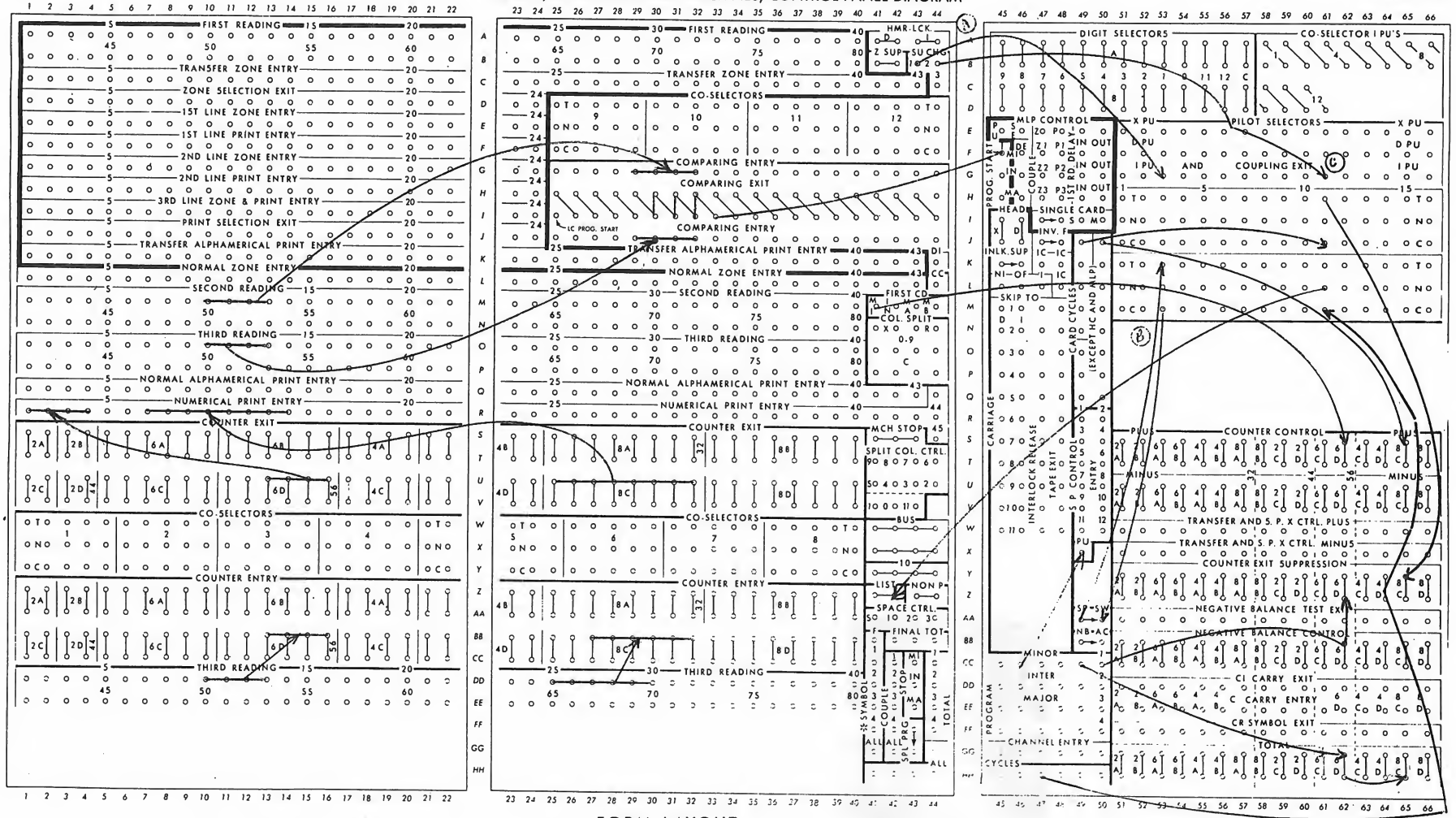
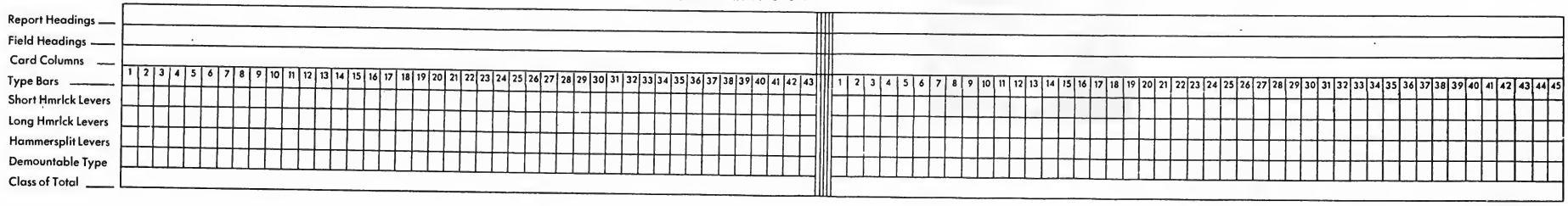


Figure 18.

FORM LAYOUT



(7-61:20M-S)

Store No.	Dept. No.	Sales No.	Net Sales by salesman	Net sales by dept.	Net sales by store
8	16	45	650700		
		76	1250000		
		178	5000CR		
		230	6500000		
		420	150060	8545760	
	20	11	4500CR	4500CR	
	24	100	1000000		
		120	12145600	13145600	21686860
12	56	56	2500CR	2500CR	2500CR

Figure 19.

called the "low order" counter as it contains the units position of our accumulated amount. This counter is being coupled with counter 2D to enable us to accumulate an 8-position total. Counters which are coupled are impulsed to add and/or subtract with the same impulse. Coupling is accomplished by wiring from the CI hub of the low order counter to the C hub of the high order counter. Our intermediate counter consists of 4A and 4B with 4B as the low order counter. For our major totals, we have used an 8 position counter. Since it is large enough to contain our total, we do not couple it with another counter.

We have assumed in this problem that counters 8B, 8C and 8D are being used for other purposes and are not available. This is the reason why counter coupling is required.

B. Where counters are coupled and subtraction is involved, the negative balance test exit hub of the high order counter is wired to the negative balance control hub of the high order counter and then from the common neg. bal. control hub to the neg. bal. control hub of the low order counter.

C. To couple counters, as was mentioned in (A) above, we wire from the CI hub of the low order counter to the C hub of the high order counter. To complete our required wiring for counters which are subtracting, we wire from the CI hub of the high order counter back into the C hub of the low order counter.

D. Both intermediate and major program exits are wired to a bus hub and from the common bus hub to the "S" Space Control hub (AA, 41). This hub, when impulsed will suppress spacing for that machine cycle. The machine will not space as it prints both intermediate and major totals. Normally, the 402 will space once before an intermediate or major total cycle.

E. The major first card impulse is wired to Space Control 3 hub (AA, 44) through the common plus hub of counter 2A; this will cause the machine to triple space before group indicating the major control group.

F. The intermediate first card impulse is wired to the Space Control 2 hub (AA, 43) through the common pickup hub of co-selector 1 to cause the 402 to double

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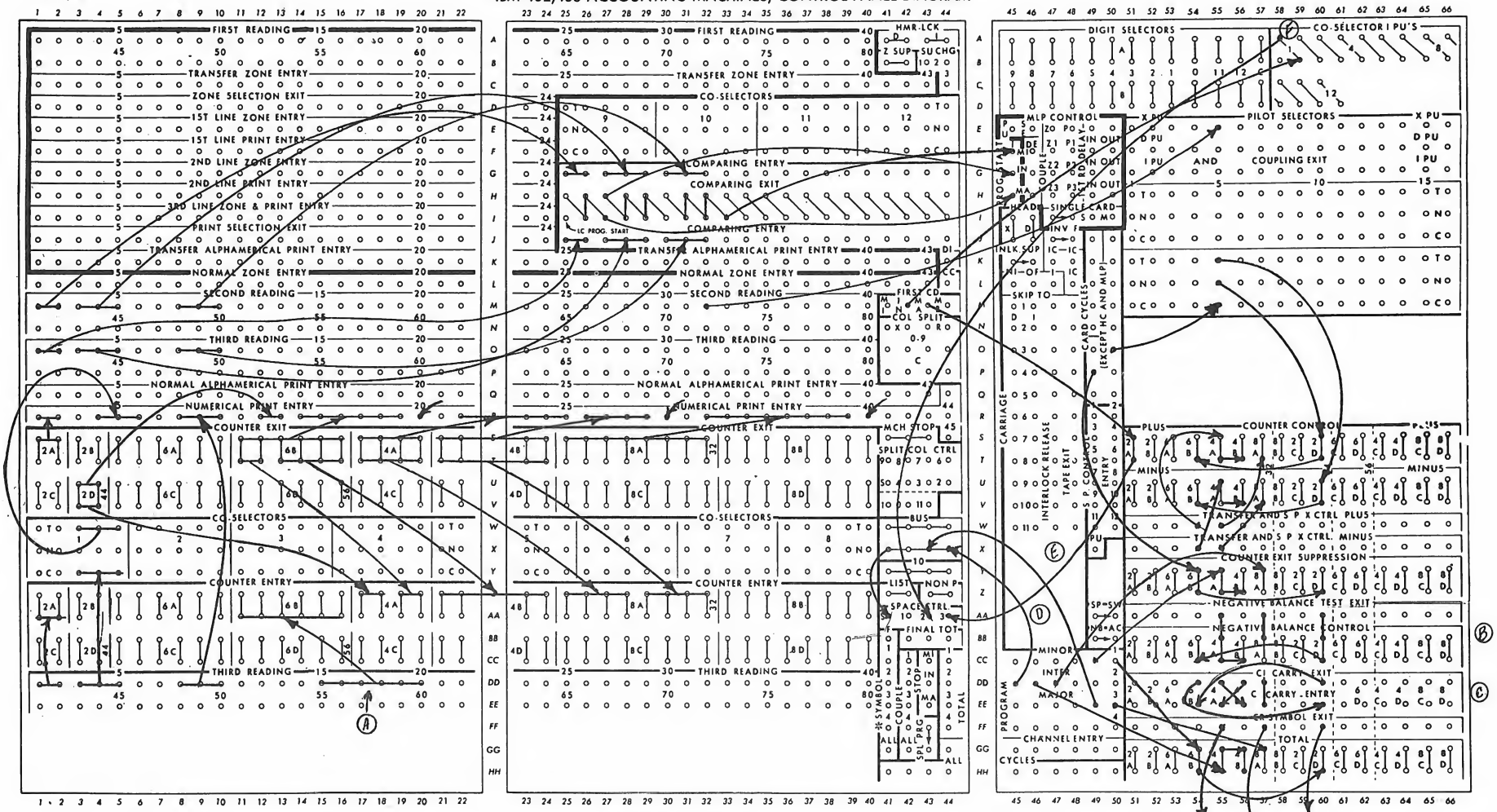


FORM LAYOUT

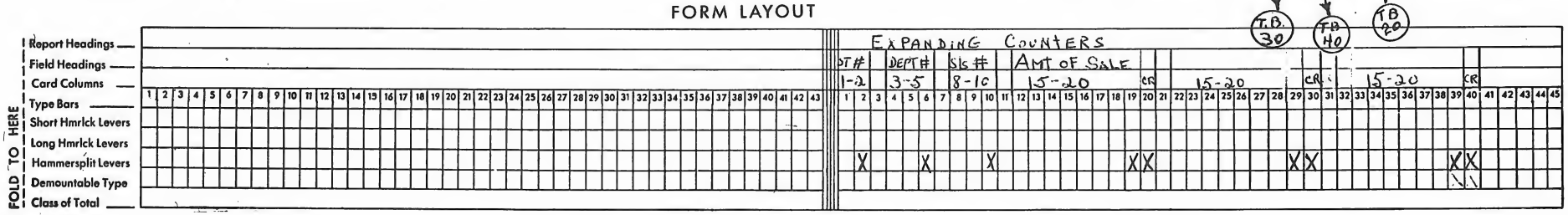


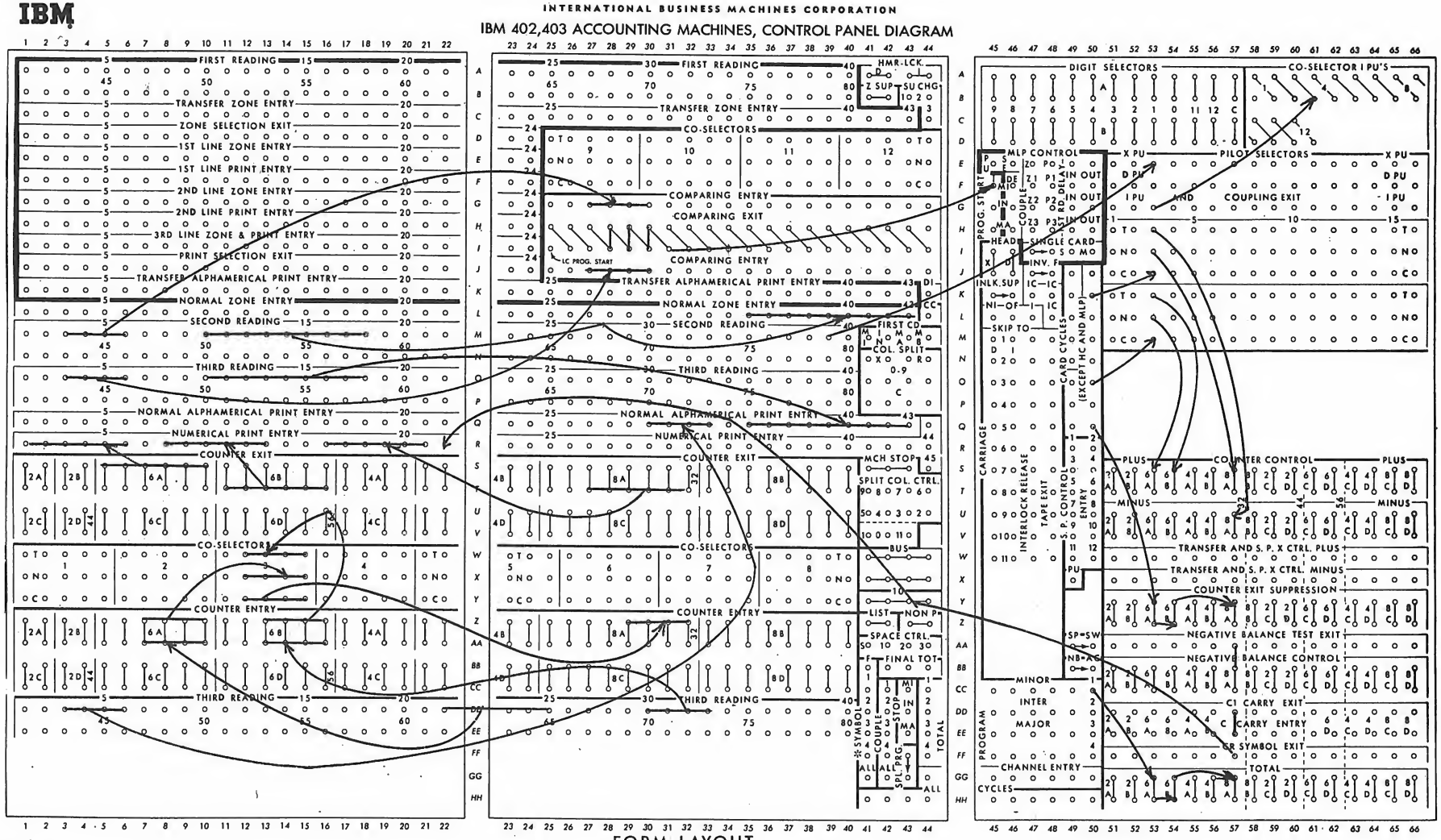
Figure 20.

space before group indicating the intermediate control group.

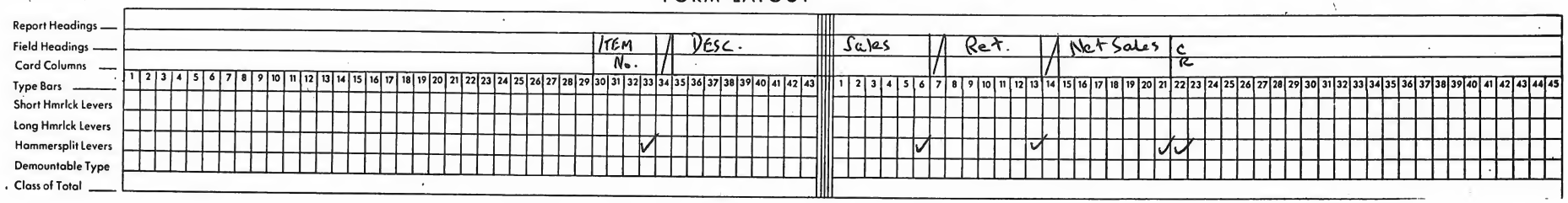
The balance of the control panel diagram illustrates wiring principles which should be examined by you as they will serve as an excellent review of total transfer and group indication techniques.

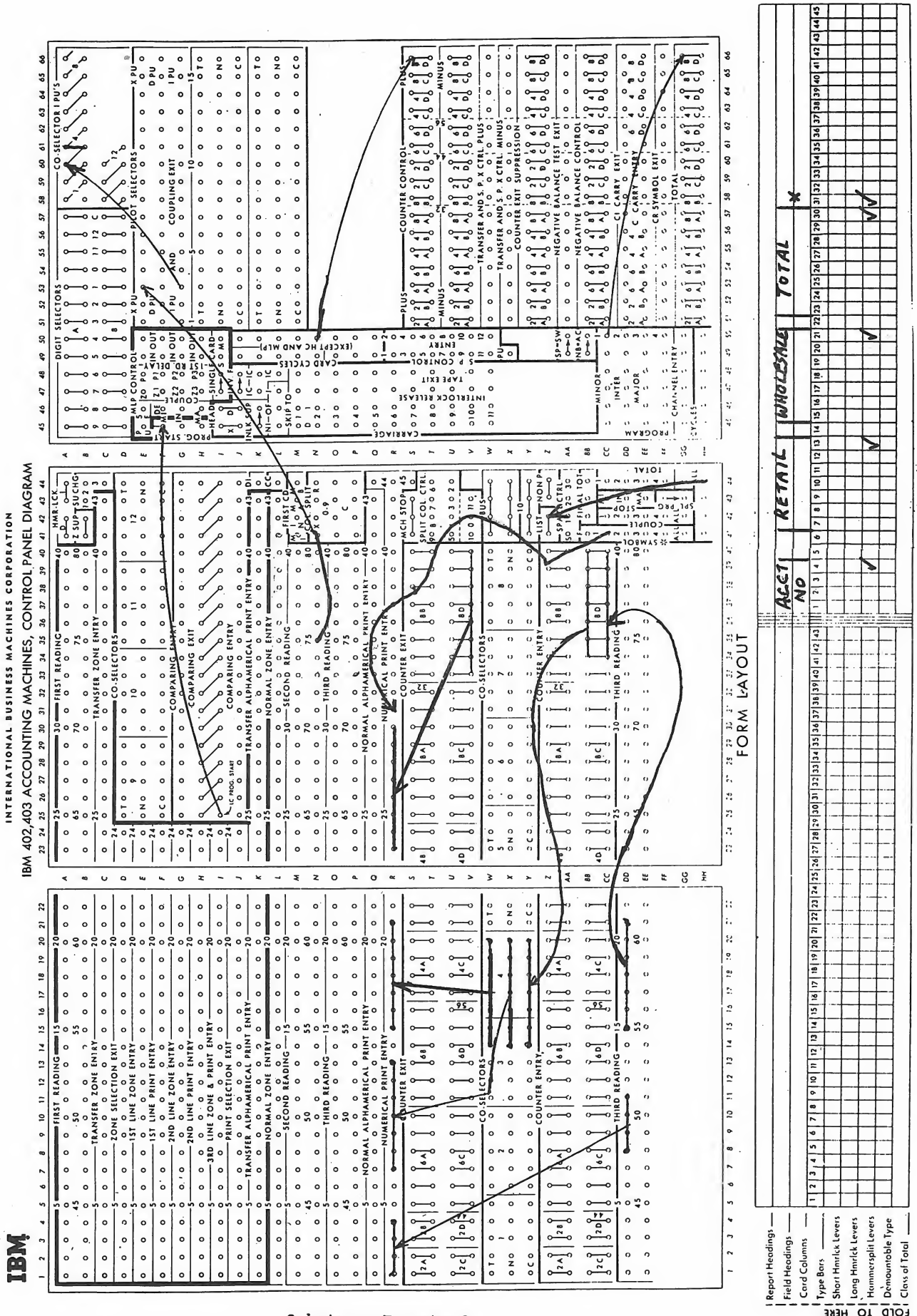
NOTE: When counters are coupled and subtraction occurs, either the high-order counter's CR Symbol Exit hub, or the low order counter's CR Symbol Exit hub may be wired to an even numbered numeric typebar to print the CR indication if the total in the counters is negative.

Solution to Exercise 1.



FORM LAYOUT





Solution to Exercise 2.

Solution to Exercise 3–402.

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IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM

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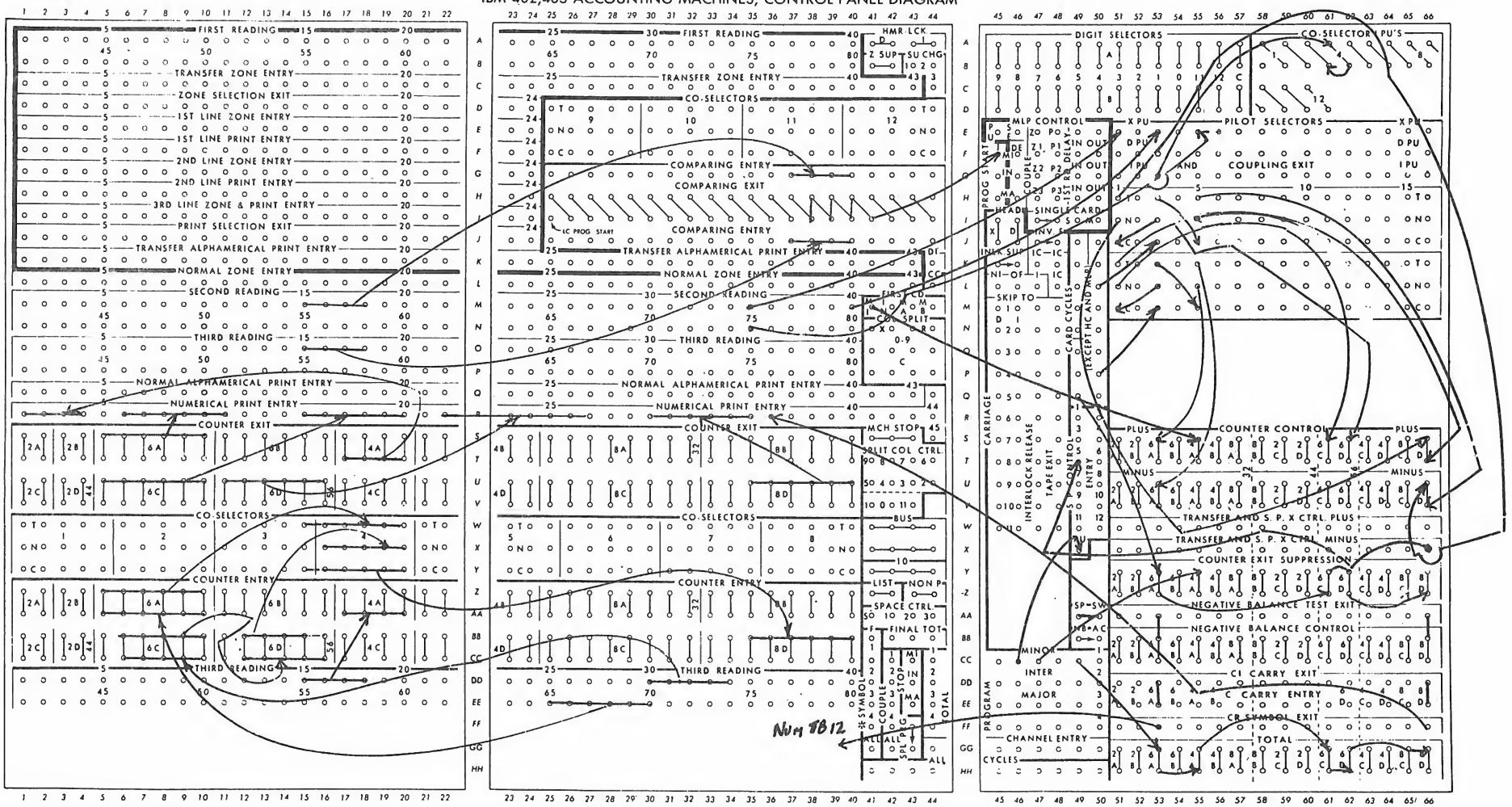
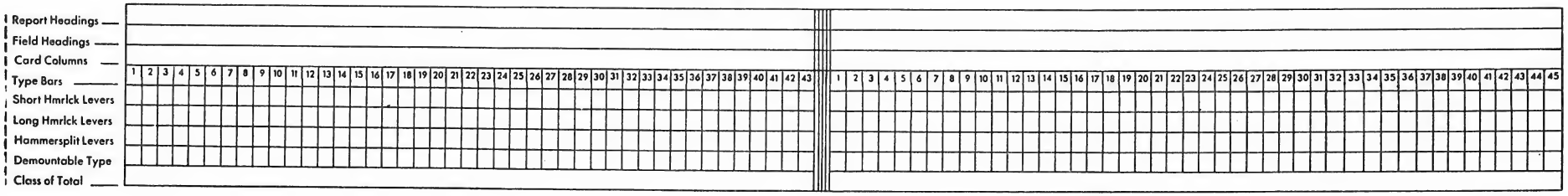


FORM LAYOUT



(7-61:20M-S)

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513—514 AUTOMATIC REPRODUCING PUNCH, CONTROL PANEL

FOR SUMMARY PUNCHING—ALPHABETIC ACCOUNTING MACHINE

Form X24-9188-9
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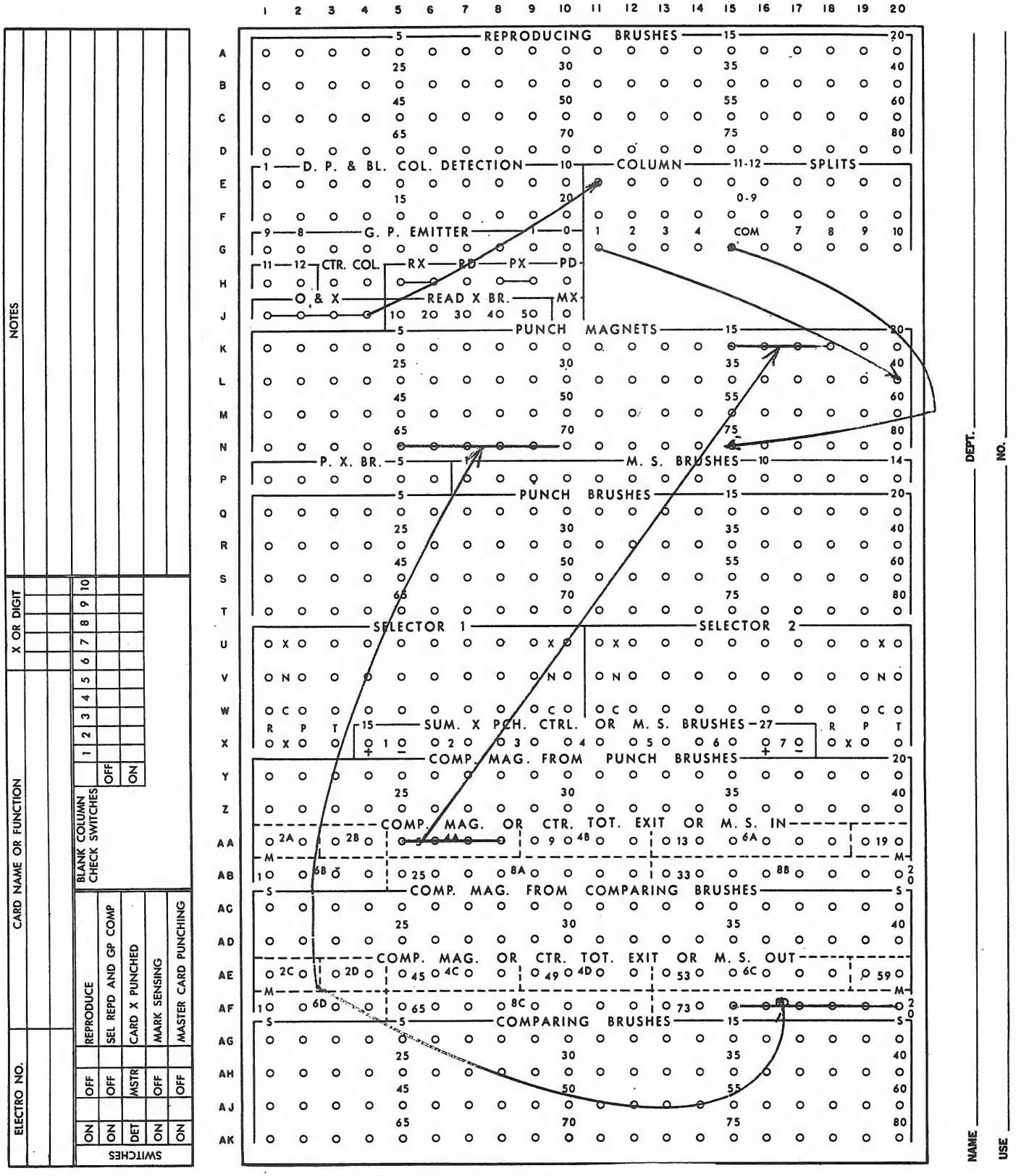


Solution to Exercise 3—514.

EXAMINATION - Lesson 18

Refer to Figure 21. Answer the following questions True or False. If True, mark an X in Box A; if False, mark an X in Box B.

1. Intermediate program control is on the field c.c. 1-5.

2. Card columns 1-5 are wired correctly to group indicate.

3. This is a tabulated report.

4. Counter 6B will add c.c. 15-20 from X75 cards and c.c. 9-12 from NX75 cards.

5. Counter 6B will add c.c. 9-12 from X75 cards and c.c. 15-20 from NX75 cards.

6. Counter 4B would be called the low-order counter.

7. The CI to C hubs of 4B and 4A are wired correctly.

8. Counter exit suppression of 4A-4B should be impulsed from card cycles

9. Counter exit suppression of 4A-4B should be impulsed from the minor program exit hub.

10. An asterisk will print from t.b. 25 at the time the intermediate total prints.

11. Counters 4C & 4D are coupled.

12. Counter 4C is the low-order counter.

13. Counters 4C-4D are adding c.c. 23-27 from NX75 cards and subtracting c.c. 23-27 from X75 cards.

14. Counter exit suppression of counters 4C-4D should be impulsed from card cycles.

15. Negative balance test exit to negative balance control of counters 4C-4D is wired correctly.

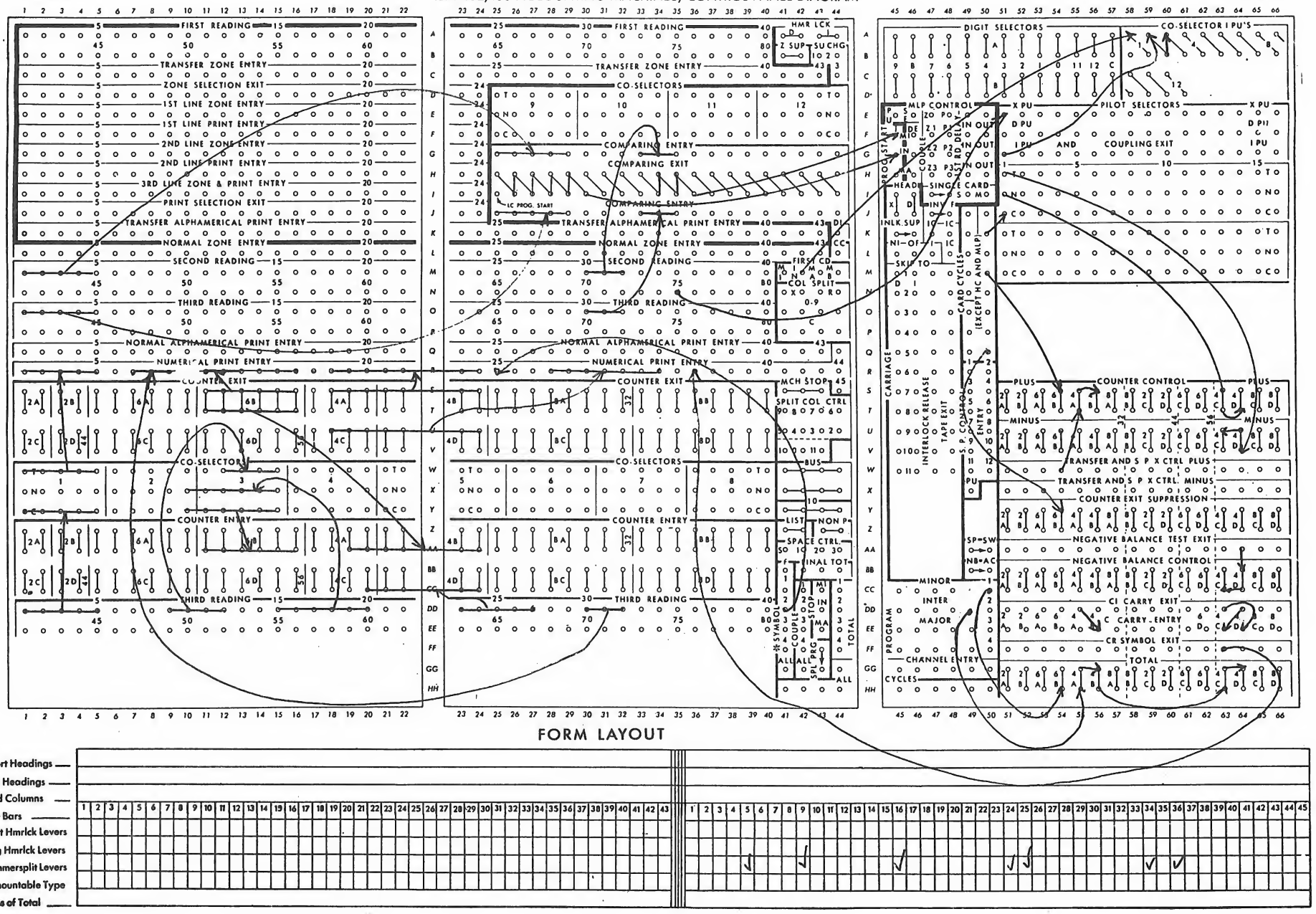
16. CI to C of ctrs. 4C-4D is wired correctly.

17. A CR symbol will print in t.b. 36 at the time 4C-4D clears should this counter group be negative.

18. The proper hammersplit levers are raised.

19. Counter exit suppression of counters 4C-4D should be impulsed from minor program exit.

20. Co-selectors 2 and 3 will be transferred at the time X75 cards are passing third reading.


IBM
INTERNATIONAL BUSINESS MACHINES CORPORATION
IBM 402,403 ACCOUNTING MACHINES, CONTROL PANEL DIAGRAM
Form X24-9327-5
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FIRST READING
TRANSFER ZONE ENTRY
ZONE SELECTION EXIT
1ST LINE ZONE ENTRY
1ST LINE PRINT ENTRY
2ND LINE ZONE ENTRY
2ND LINE PRINT ENTRY
3RD LINE ZONE & PRINT ENTRY
PRINT SELECTION EXIT
TRANSFER ALPHAMERICAL PRINT ENTRY
NORMAL ZONE ENTRY
SECOND READING
THIRD READING
NORMAL ALPHAMERICAL PRINT ENTRY
NUMERICAL PRINT ENTRY
COUNTER EXIT
CO-SELECTORS
COUNTER ENTRY
COMPARING ENTRY
COMPARING EXIT
HMR LCK
DIGIT SELECTORS
CO-SELECTOR I PU'S
MLP CONTROL
PILOT SELECTORS
COUPLING EXIT
SINGLE CARD
SKIP TO
FIRST CD
COL SPLIT
MCH STOP
SPLIT COL CTRL
BUS
LIST
NON P
SPACE CTRL
FINAL TOT
COUNTER CONTROL
PLUS
MINUS
TRANSFER AND S P X CTRL PLUS
TRANSFER AND S P X CTRL MINUS
COUNTER EXIT SUPPRESSION
NEGATIVE BALANCE TEST EXIT
NEGATIVE BALANCE CONTROL
CI CARRY EXIT
CARRY ENTRY
CR SYMBOL EXIT
CHANNEL ENTRY
TOTAL
MINOR
INTER
MAJOR
CYCLES
PROGRAM
CARRIAGE
INTERLOCK RELEASE
TAPE EXIT
S. P. CONTROL
CARD CYCLES
(EXCEPT HC AND MLP)
FORM LAYOUT
Report Headings
Field Headings
Card Columns
Type Bars
Short Hmrick Levers
Long Hmrick Levers
Hammersplit Levers
Demountable Type
Class of Total
FOLD TO HERE

Figure 21.

I.B.M. DATA PROCESSING
AND COMPUTER PROGRAMMING

LESSON #19

TABLE OF CONTENTS

Work Shop Problem - Part I

ELECTRONIC COMPUTER PROGRAMMING INSTITUTE

WORKSHOP PROBLEM - PART I

In this lesson we are going to be concerned with the creation of our detail cards and the processing of these cards to prepare them for a series of 402 reports.

A furniture manufacturing company has salesmen who travel throughout the country visiting furniture retail stores and accepting orders for new merchandise. These orders are written on order forms similar to the one shown in Figure 1 and are forwarded to the central office. Should merchandise be returned, a form exactly like the order form is prepared and sent to the central office marked at the top "Return."

Orders and returns are brought to the key punch section and punched into cards such as the one shown in Figure 2. The following fields are punched:

Acct. No.	card col.	1-5
Salesman No.		6-8
Item No.		9-13
Quantity		14-17
Unit Price		50-54

The cards are separated into two groups; orders and returns.

The following procedure is then followed:

1. A master card is keypunched which contains the field, Date Processed in card col. 75-80. It is then placed in front of the order cards. Prepare the required 514 reproducer control panel diagram to gang punch card col. 75-80.

2. This same master card is placed in front of the return detail cards. Pre-

BILL TO
Charles Furniture Store
18 James St.
St. Louis, Mo.

ACCOUNT NO, 16345
SLS. NO. 132

PERSON WRITING ORDER | BUYER'S NAME | DATE

APPROX. SHIPPING DATE ☐ SOON AS POSSIBLE | SHIP VIA ☐ RAIL ☐ TRUCK ☐ BEST WAY

QUAN.	ITEM NO.	BED SIZE -OR- SKIRT STYLE	DESCRIPTION (FINISH ABBREVIATIONS: N-NUTMEG S-SPICE BROWN W-WALNUT P-PLATINUM F-FRUITWOOD)	FABRIC NO. - OR - TABLE TOP COLOR	UNIT PRICE
24	628		Arm Chair		7 25
6	640		Dinette Table		46 00
4	683		Buffet		76 50
100	1460		End Table		6 50
80	1461		Corner Table		7 50
60	1463		Cocktail Table		11 00
10	2860		Sofa		108 00
12	2861		Arm Chair		45 00

Figure 1.

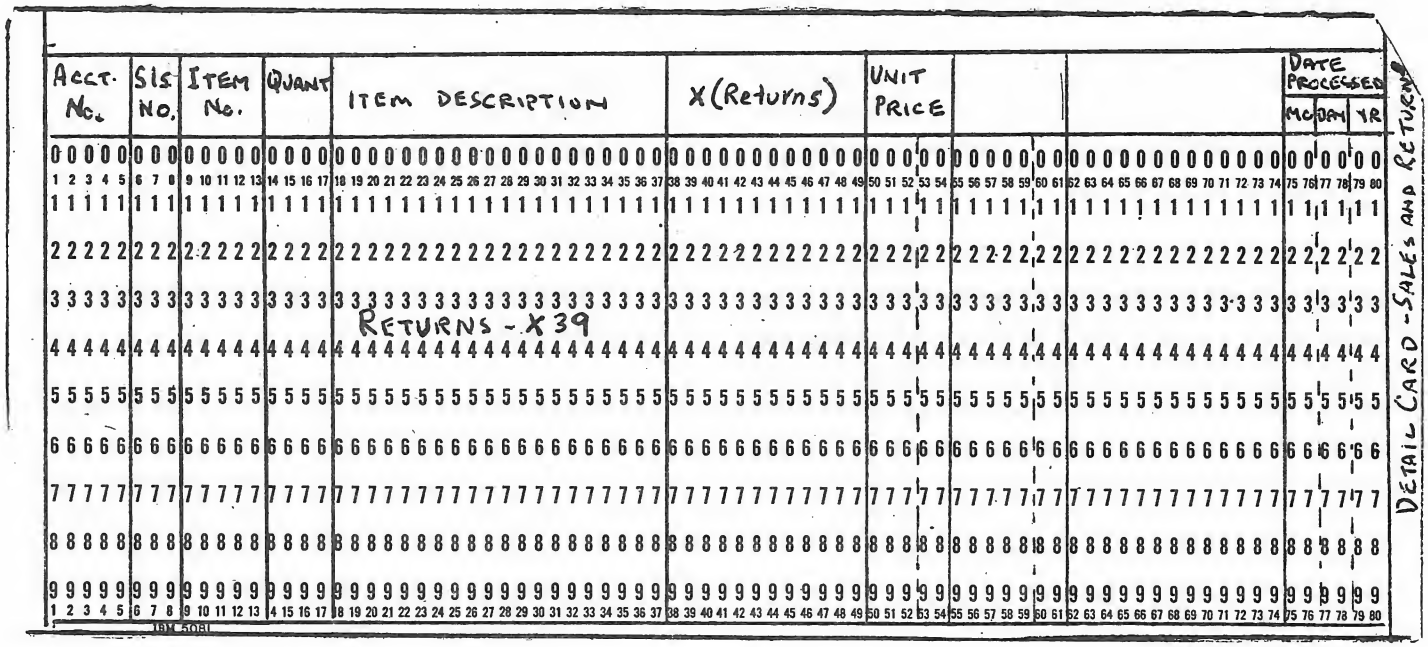

Figure 2.

pare a 514 reproducer control panel diagram to gang punch the Date Processed field and also to punch an "x" in card col. 39.

The return cards are placed in back of the order cards and a proof listing is run on the 402. A sample of this report is shown in Figure 3. This listing is checked against the original orders and returns to see that the cards have been punched correctly. A final total of quantity is printed. Should cards require correction, they are re-punched and then the entire job is re-listed. Diagram the required 402 panel to prepare this listing and total.

4. Our next operation will enable us to intersperse gang-punch our description into the detail cards. We have in our files a master deck of Item Description cards similar to the one shown in Figure 4. There is one card for each item

Acct. No.	Sls. No.	Item No.	Quantity
16345	132	14768	35
16345	132	23456	6
16345	132	23457	100
9988	65	5679	18
9988	65	10029	8
8800	23	10028	7
8800	23	10065	28
8800	23	10068	32
8800	23	10072	8
11657	102	10072	4CR
11657	102	10028	1CR
8990	65	14768	5CR
			6578 *

Figure 3.

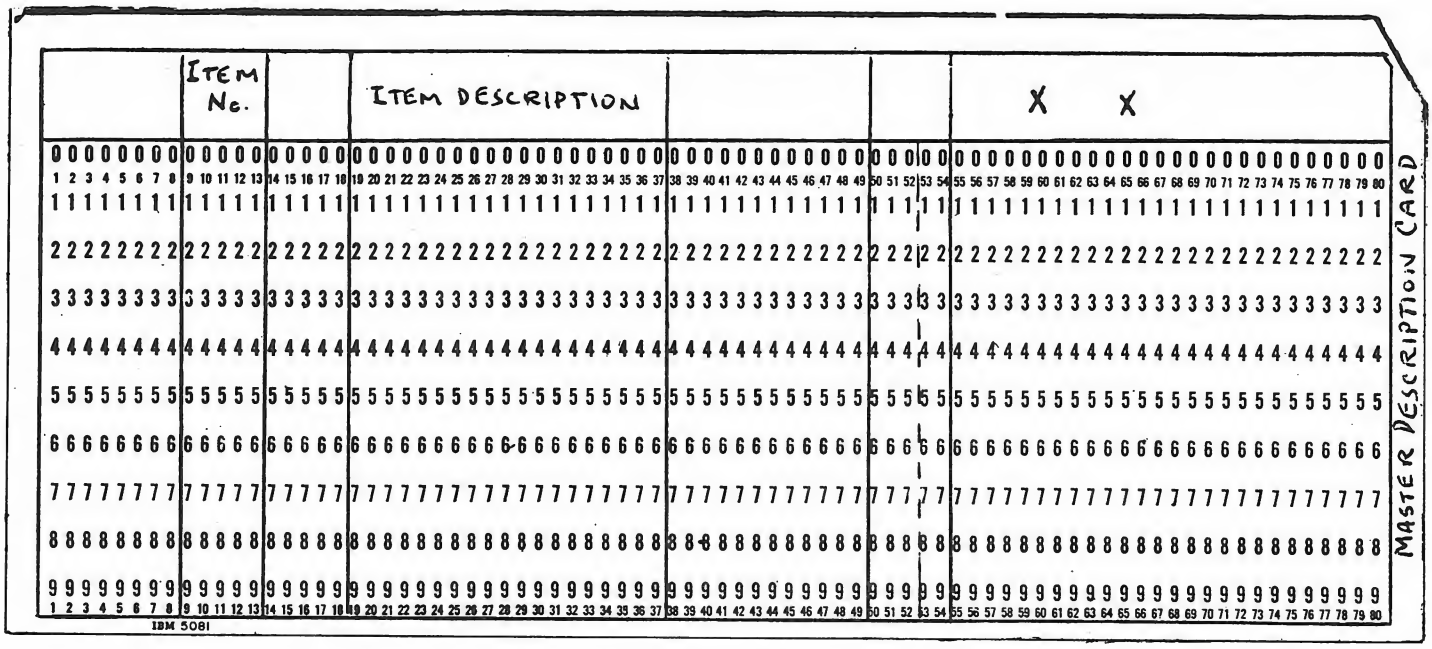

Figure 4.

sold by the company. These cards contain the following fields: item no.; and item description. All master cards have "X" punches in both card cols. 60 and 65.

All of our order and return detail cards are sorted into sequence by item number, c.c. 9-13. They are going to be collated with our master file. The master file will be placed in the primary and the detail cards are to be placed in the secondary. You are to prepare the control panel diagram to merge equal detail cards with the master cards. Select unequal detail cards as these have no master cards and should not be punched. Check sequence in the primary. Pocket 2 in the collator will contain all the master cards and equal detail cards. Pocket 4 will contain unequal detail cards. An indication of the contents of pocket 2 (the merge pocket) is contained below:

Pocket 2
2861 Detail
2861 Master
2860 Detail
2860 Detail
2860 Master
2859 Master
2857 Master
1463 Detail
1463 Master (the first card in the machine)

All master cards fall into pocket 2 even though some may not have any detail cards. This will not affect our interspersed gang punch operation.

Master cards will be key punched for unmatched details. The new masters and their detail cards will then be hand-filed into our main deck of cards.

5. Our cards are now ready to be interspersed gang-punched and compared. We are going to punch the field "description" from X master cards to NX detail cards. We are going to compare the field which was punched and also the item number field. Assume that PX brush 4 is set over c.c. 60, and PX brush 5 is set over c.c. 65. The correspondingly numbered RX brushes are set over the same card columns. Prepare the required control panel diagram and indicate the setting of all switches.

6. After interspersed gang-punching, the cards are placed in the sorter and X65 cards (the master description cards) are selected. The master cards are placed in our file for use at another time and we will resume processing our detail cards.

7. The detail cards are then sorted into sequence by account number and re-listed using the same control panel as the one used in step 3. The new total is checked to the original total. They should agree unless during processing we misplaced a card. Should we have lost a card, we would have to check our listing in detail until we find the missing card (it is on the original listing and missing on the new listing.) Missing cards would be re-punched and processed and placed in the main deck. If we have done our job carefully and correctly, our totals will agree and all detail cards would have in them at this time all the fields contained in the card shown in Figure 2. They are now held aside in a file for future processing in the next lesson.

In review, you are required to submit the following material:

Step 1. A 514 diagram
Step 2. A 514 diagram
Step 3. A 402 diagram
Step 4. An 077 or (085) diagram
Step 5. A 514 diagram

In lesson 20 we will prepare a series of 402 reports using the detail cards prepared in this lesson.

Figure 5 is a flow chart which illustrates our procedure.

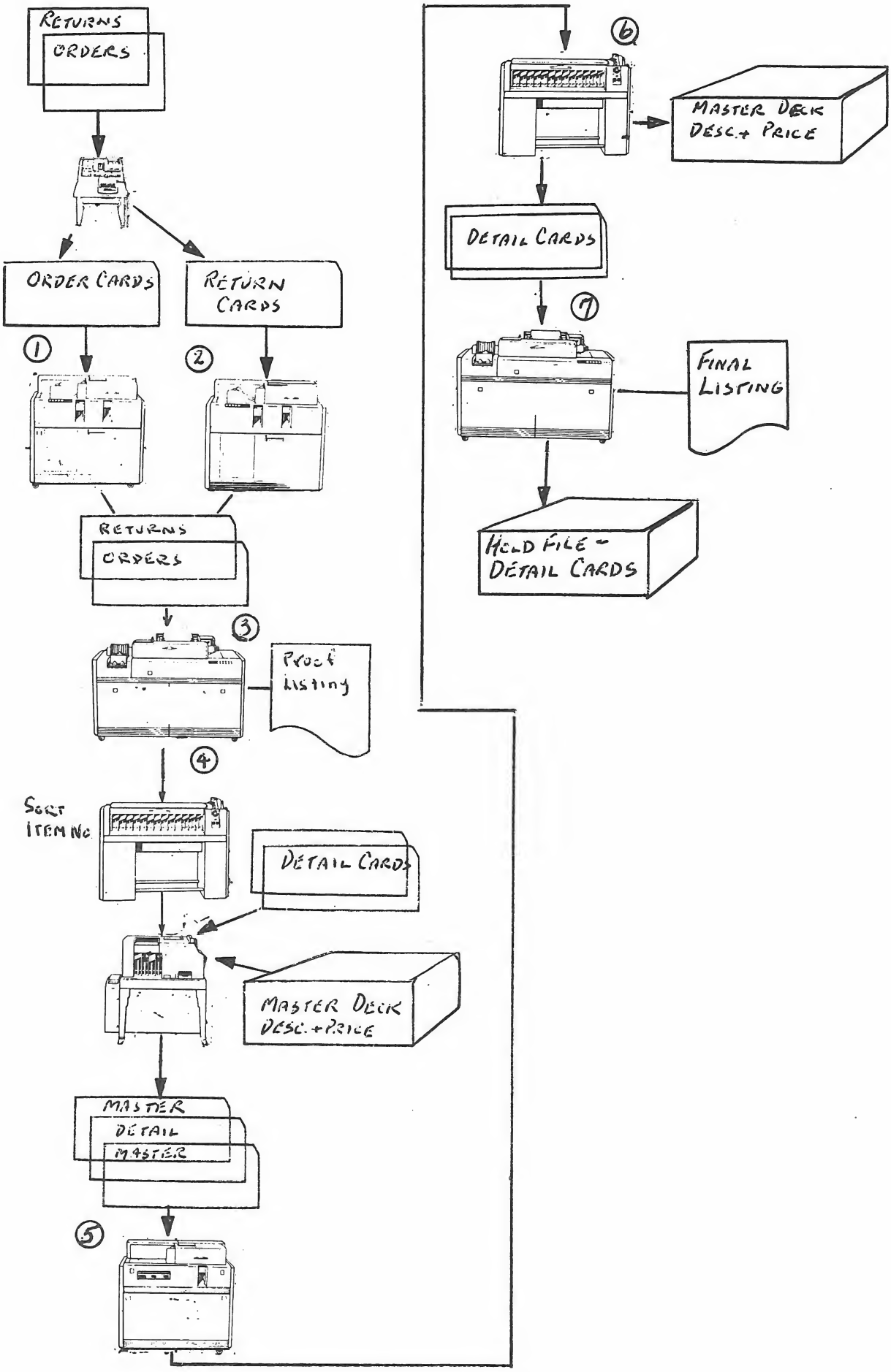
RETURNS
ORDERS
ORDER CARDS
RETURN CARDS
1
2
RETURNS
ORDERS
3
Proof listing
4
SORT ITEM No
DETAIL CARDS
MASTER DECK DESC. + PRICE
MASTER
DETAIL
MASTER
5
6
MASTER DECK DESC. + PRICE
DETAIL CARDS
7
FINAL LISTING
HOLD FILE - DETAIL CARDS

Figure 5.

I.B.M. DATA PROCESSING AND COMPUTER PROGRAMMING

LESSON #20

TABLE OF CONTENTS

Work Shop Problem - Part II

Supplement

ELECTRONIC COMPUTER PROGRAMMING INSTITUTE

In this part of our workshop problem, we are going to prepare two 402 reports from the cards that were created and processed in the last lesson. Let us list the steps to be followed to complete our processing:

1. Each day, our cards have been punched and processed, a total for the day has been tabulated, and the cards have been filed. At the end of the week, we will have five groups of cards, one for each day, and five totals. Before processing these cards, we are going to re-tabulate them to be sure that none have been removed from the file. We are going to accumulate totals for each day to compare to our original totals and we will also accumulate a total for the entire week. The cards to be used have the format shown in Figure 2, lesson 19. They are now in sequence by date processed, c.c. 75-80. The report we are to prepare is shown in Figure 1.

Tabulation by Processing Date	
Date	**Quantity**
112661	6578
112761	14670
112861	18765
112961	7650
113061	3200
	50863*

Figure 1.

You can assume that daily totals or weekly totals will never be negative. Remember, returns have an X in c.c. 39.

Item No.	Description	Quantity	Weekly Total
2367	ARM CHAIR	657	
5467	SOFA	20CR	
8800	ROUND TABLE	1345	
12340	STEP END TABLE	657	
12340	END TABLE	879	
12341	CORNER TABLE	1230	
12890	HUTCH	8CR	
24569	CHEST	718	
			50863*

Figure 2.

2. We have now proven our daily totals and we have created a weekly total of all quantities. We are now going to analyze our cards to see what items are selling. The cards are sorted by item number, c.c. 9-13. We are going to prepare the tabulation shown in Figure 2. Minor control is on item number. The last total is a final total of all cards which should agree with our weekly control total which was developed in step 1 above.

This lesson requires you to submit:

Step 1. A 402 diagram
Step 2. A 402 diagram

LESSON 20 - SUPPLEMENT

Card Handling

The IBM card is made of high-grade paper by precision equipment to insure that each card is the same over-all dimensions. This is vitally important as the card feed units of all machines have been engineered to accept cards of a particular size and thickness.

When handled properly, IBM cards should retain their physical characteristics, free from nicks, mars, folds or tears. If properly stored so that they do not warp, the cards can be used hundreds of times without causing a machine to stop.

The responsibility for proper card handling is that of the machine operator. Before cards are placed in a machine, they should be joggled. This term was used before in connection with the sorter. Cards should be joggled before being placed in any machine. Each machine has a joggle plate which is nothing more than a flat horizontal surface with an upright section at one end. See Figure 1. To

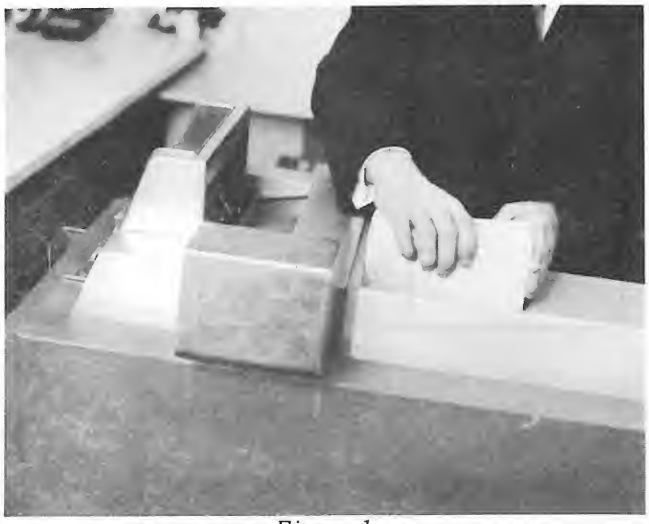

Figure 1

joggle cards, the operator takes a handful (300-400 cards), and places them on the joggle plate, bottom edge touching the flat surface. They are then butted against the upright surface. This causes the cards to assemble into a perfectly flat deck. They can then be placed into the feed unit of a machine and they will feed properly. Sometimes, as cards feed through a machine, they pick up static electricity which makes them somewhat difficult to joggle as they tend to stick together. This static electricity is removed by partially joggling the cards until they are fairly even on top, bottom and sides and then "riffling" the cards. Riffling is a technique whereby the operator holds the cards at one end with his right hand, bends them backwards with his left hand and then releases the cards from his left hand, one by one, rapidly, to create a fanning effect. This motion tends to dispel any static electricity that may have collected on the cards.

Figures 1-4 illustrate the proper way to handle cards. These cards are going to be fed into a sorter. In Figure 1, the cards are being joggled. They are placed on the joggle surface of the sorter with the face of the card away from the operator. They are held not too tightly by the right hand and butted with the fingers or lower portion of the palm of the left hand, against the upright portion of the joggle area. They are butted with a slightly upward motion so that they tend to rise slightly into the palm of the right hand. As they fall back into place, a final smooth alignment is accomplished by tapping the top and left hand edge. They are then lifted by the right hand toward the feed unit, (figure 2).

Figure 2

At this point, they are in a perfectly square deck. The card weight which was resting at the base of the feed unit is lifted with the left hand so that the cards may be placed in the

feed unit, (figure 3). After the cards are placed in the feed unit, the card weight is placed on top of them, (figure 4). The card weight provides the pressure required to cause the cards to feed properly. It is particularly important at the time the last few cards are being fed.

Figure 3

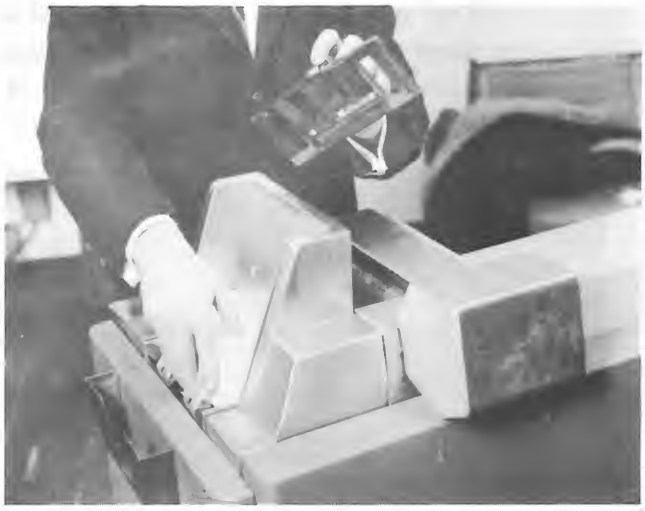

Figure 4

Figure 5 illustrates how cards are placed in the feed unit of the reproducer. They have been joggled against the joggle plate which can be seen in the upper middle portion of the photograph (the plate that appears to have pin holes in it). The card weight is held in the right hand as the cards are placed face down, 12 edge first into the punch side of the reproducer. The card weight will then be placed on top of the cards and the machine is ready to operate.

Figure 5

Another example of card feeding and handling is shown in Figure 6. Here, the cards have been joggled and they are being placed in the read unit of the 402 accounting machine. They are fed in face down, 9 edge first. The card weight is in the operator's left hand.

Figure 6

Nothing can replace actual practice when it comes to acquiring the physical skill necessary to handle cards properly. However, this skill can be acquired very rapidly.

Cards are not always placed into all IBM machines the same way. They may be placed into the machine face down or face up, 9 edge first or 12 edge first. Listed below is the proper way of placing cards in each machine we have studied:

024 keypunch: cards feed face toward the operator, 9 edge down
552 interpreter: face up, 12 edge first
082 sorter: face down, 9 edge first
514 reproducer: face down, 12 edge first
077 collator: face down, 9 edge first
402 accounting machine: face down, 9 edge first

Each machine has directions for the operator affixed near the feed units. With continued use, the operator easily remembers the operating characteristics of each machine.

When we have a file of cards, they are usually stored in metal trays when the cards

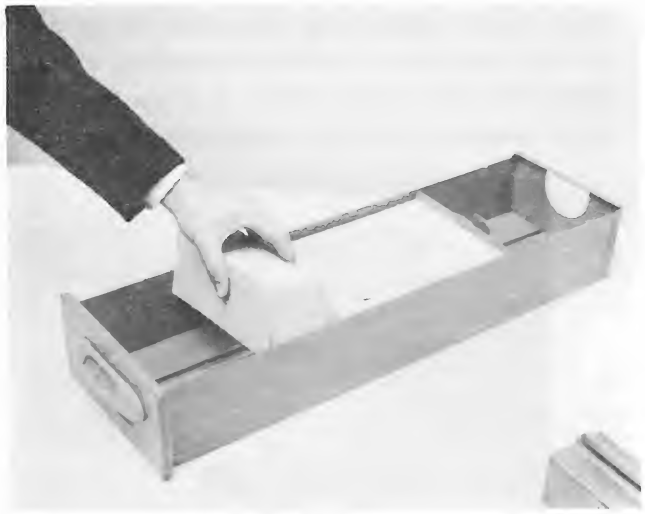

Figure 7

are not in use. The trays have pressure plates in the back which can be moved to compress the cards and prevent them from warping. When feeding cards from trays, the pressure plate is released to permit easy access to the cards. Cards are taken from the front of the tray, joggled, and then placed in the machine. Figure 7 illustrates how the first group of cards is taken from the tray, ready to be joggled and placed in a machine. A metal block is placed in front of the remaining cards in the tray to keep them from falling forward. As the first group of cards comes out of the machine, it is placed in the front of the tray. The cards in back of the metal block must still go into the machine. Figure 8 illustrates the first group of cards which

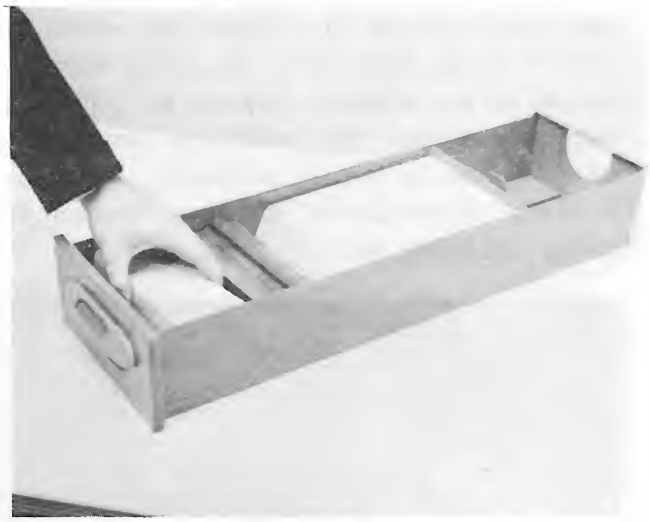

Figure 8

have come out of the machine, being placed back in the tray. Figure 9 shows the next handful of cards lifted from the tray, ready to go into the machine and the metal block pushed back to support the remaining cards which are in the tray. This procedure is followed until all cards from one tray have been processed; other trays may follow and they would be handled the same way. After the cards have been processed, the pressure plate is moved forward to compress the cards while they are being stored.

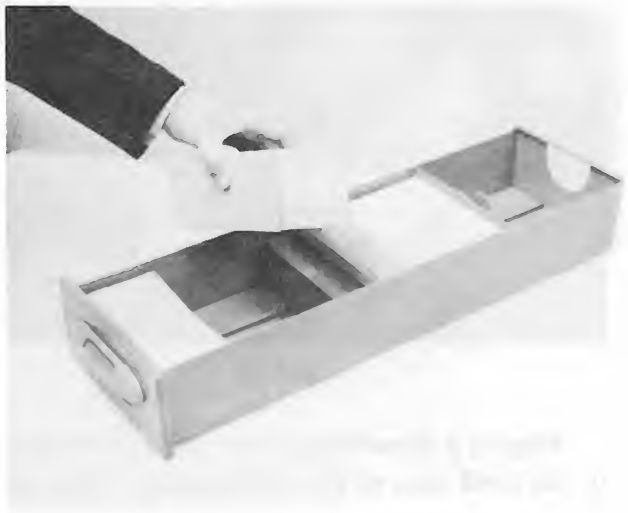

Figure 9

When cards are being processed by a machine that feeds cards face down (082, 514, 077 and 402) they are processed from the front of the tray to the back. The cards in the front of the tray are fed first and are followed by the next group until the cards in the back of the tray are fed last. This pro-

cedure is illustrated and described above. A variation of this procedure is used when processing cards in machines that feed cards face up (the 552 interpreter). In this instance, the first cards in the machine are taken from the back of the tray and the operator works his way towards the front of the tray.

When cards are fed into the machine from the back of the tray, as they come out of the machine they are replaced in the tray from rear to front.

Figure 10

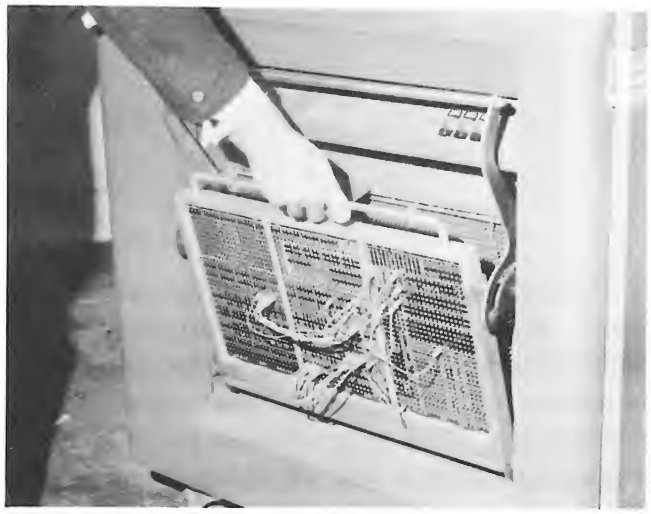

Figure 11

Figures 10, 11 and 12 illustrate the proper way to place a control panel into an IBM machine. The machine illustrated is the 402 accounting machine; however, the same procedure would be applied to any machine.

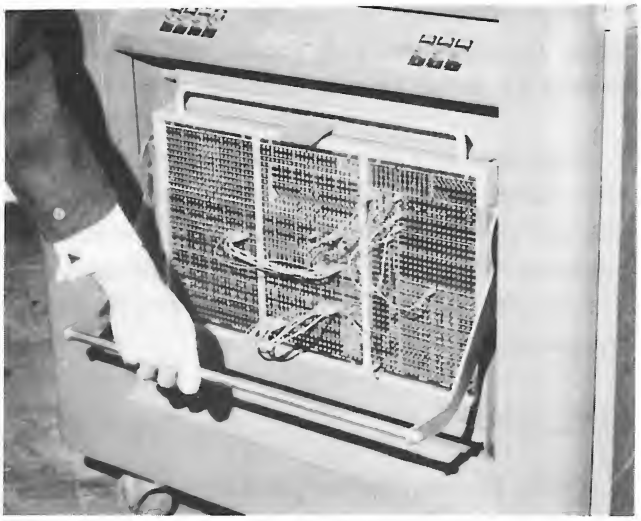

Figure 12

1. The control panel fits into a rack. The rack is positioned to house the panel by lifting the vertical handle. The sides of the rack protrude slightly so that the panel can be positioned.

2. The panel is slid into the rack until it fits firmly and rests on the base of the rack. (Figure 11.)

3. The operator grasps the rack handle and presses it downward. The rack moves forward bringing the control panel into contact with the metal prongs that make contact with the internal circuits of the machine (Figure 12). These prongs can be seen clearly in Figure 10 which is a view of the 402 just before the control panel is slid into the rack.

4. To remove the panel, the handle is raised, the rack moves back and the panel is lifted out.

Procedure Development

The primary function of the IBM department is to supply information to the management of the company to enable the company to function efficiently. In order to supply this information, it is the responsibility of someone in the company - the manager of the IBM department, or other men or women called "systems analysts" - to analyze the needs of

management and based on this analysis develop the necessary systems and procedures to satisfy these needs.

A procedure is nothing more than the logical development of job steps necessary to change raw factual information into finished reports. The procedure makes the most efficient use of the available personnel and equipment.

Flow Charts

Once the procedure is conceived and developed, it is important to place it on paper so that it may be examined, revised or explained. Since a procedure is a series of related job steps which must occur in a given sequence to complete the finished reports, these job steps can be indicated on a flow chart to give a picture of the entire procedure. This picture tends to show the job steps involved, indicates their sequence, and points out the main elements of the procedure. It is always an aid to constructive thinking to make a picture which will show the main factors involved and their relation to each other. The act of making the flow chart will provide a clearer understanding of the procedure. Figure 13 is a typical flow chart.

One of the best methods of teaching is the use of illustrations. The flow chart is a picture used to illustrate the procedure to supervisors or operators. The purpose of the flow chart is not just to have a pretty picture, but to bring out forcibly and visibly important facts which assist in clarifying thinking and conveying the facts clearly to others. The leading facts should stand out clearly; they should be simple, obvious and easily grasped by anyone. To realize these objectives, certain points should be kept in mind:

1. Any work which can be performed can be charted.

2. The flow chart should show in a clear simple picture the flow of work into the department and the flow of work within the department.

3. The wording on the flow chart should be as brief and clear as possible.

4. The type of work performed at each job step must be clear.

5. The chart must not be cluttered with detail so that the over-all picture is lost.

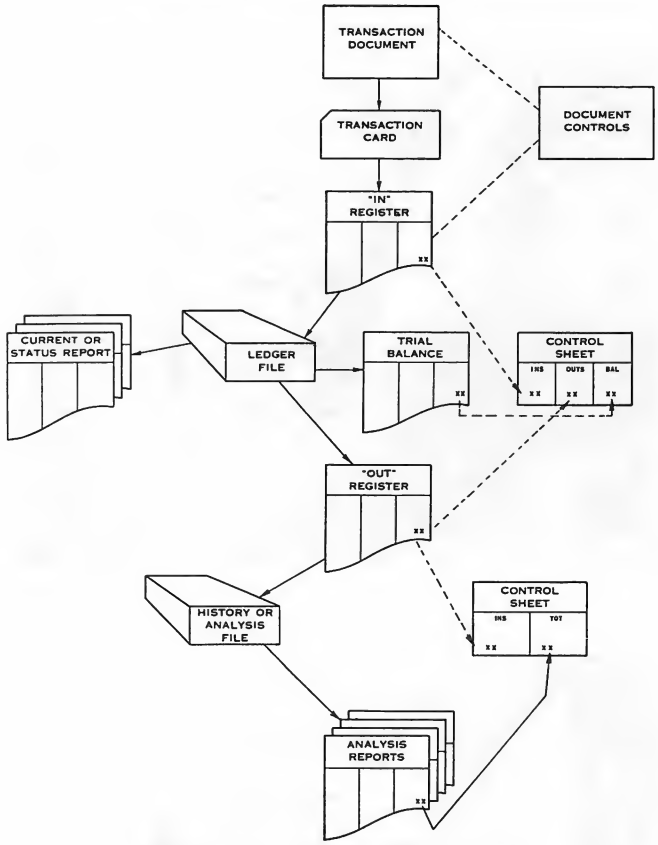

Figure 13. General Flow Chart

Figure 13 illustrates a "general" flow chart. It is a pictorial representation of the general method by which source document information is converted to final reports or documents. This type of flow chart serves to give a picture of the job which the procedure accomplishes. It emphasizes the source documents (those documents which contain the raw factual data), the cards and card files used in the IBM procedure, and the final reports and documents created. These general flow charts have value in depicting the over-all procedure to management or to the per-

son or persons receiving the final reports. The source of the information is readily seen, the cards used in the accounting procedure are evident, and the various reports relating to the job are shown.

The "operational" flow chart is a pictorial representation of the specific job steps necessary to arrive at the end product. These flow charts point out the machine or clerical functions in their proper sequence and the movement of cards and documents from one operation to another. Since operational flow charts contain more detailed information than general flow charts, they would be drawn for each job to depict a portion of the entire accounting procedure. The operational flow chart is used by the IBM manager as a nucleus around which he builds his plans, schedules and operations. It is desirable, therefore, that elements common to all IBM procedures be symbolized and standardized so that they may be quickly drawn and recognized.

If many types of procedures are examined, certain common job steps and processes would be found. In an IBM installation, machine operations and clerical operations are found; cards move from job to job and documents move from step to step. Most operations are performed within the machine installation but some may be performed in outside departments.

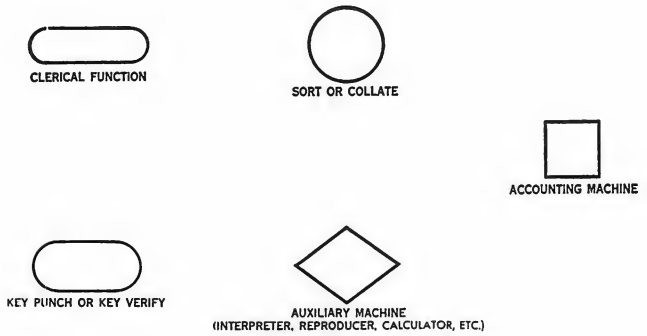

Figure 14. Flow Chart Symbols

To indicate the various machine and clerical operations on flow charts, the symbols illustrated in Figure 14 have been assigned to the respective operations. A word or two indicating the type of operation the machine is performing can be included beside or within each symbol.

Symbols that can be used to represent source documents, final reports, cards, and card files are illustrated in Figure 15.

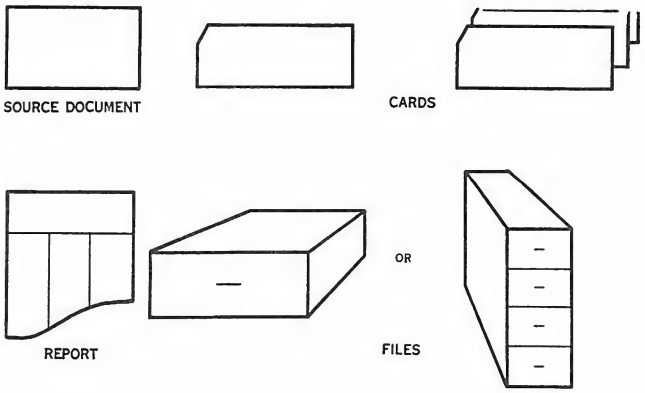

Figure 15. Flow Chart Operational Symbols

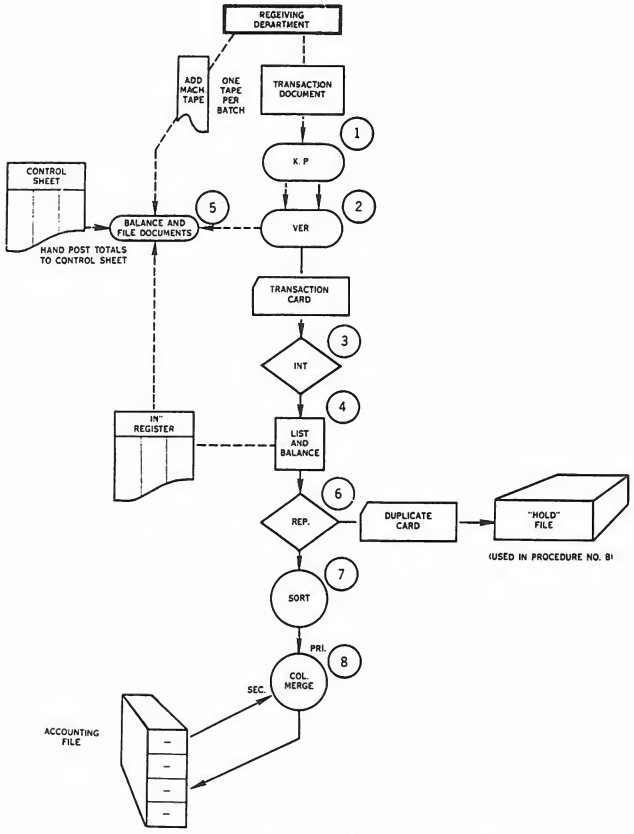

Figure 16. Operational Flow Chart

Figure 16 illustrates an operational flow chart. It depicts the operations necessary for punching the cards, preparing the IN register, and inserting the cards into the

current working file. Several of the steps are numbered and encircled. A detailed description of the operation being performed would be found in a Job Instruction Manual. Figure 17 illustrates another operational flow chart and the job instructions pertaining to it.

To facilitate drawing flow charts, a flow chart template has been developed. It is made out of transparent plastic and has the needed cut-outs. Figure 18 illustrates the template.

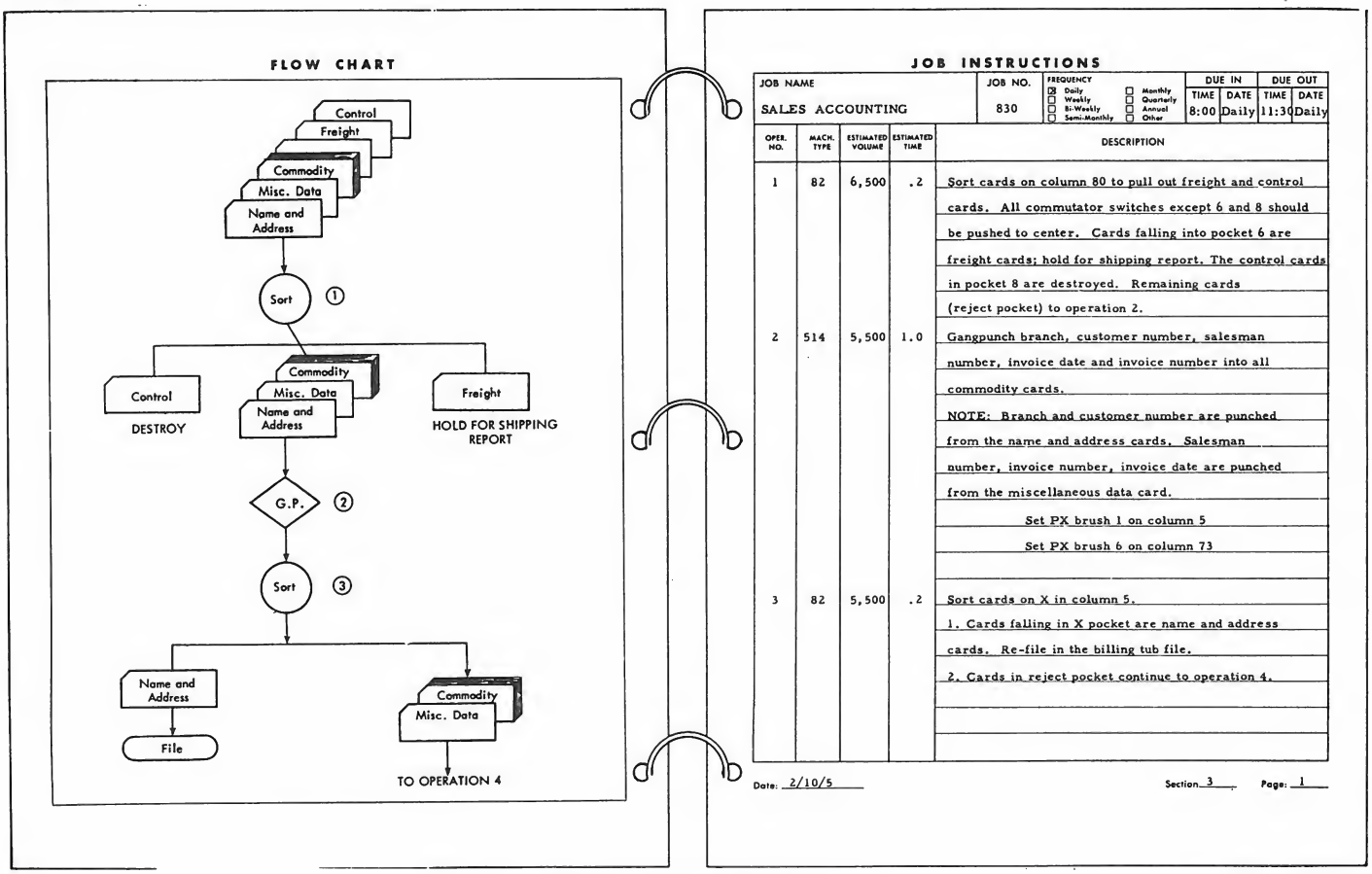

Figure 17. Flow Chart & Job Instructions

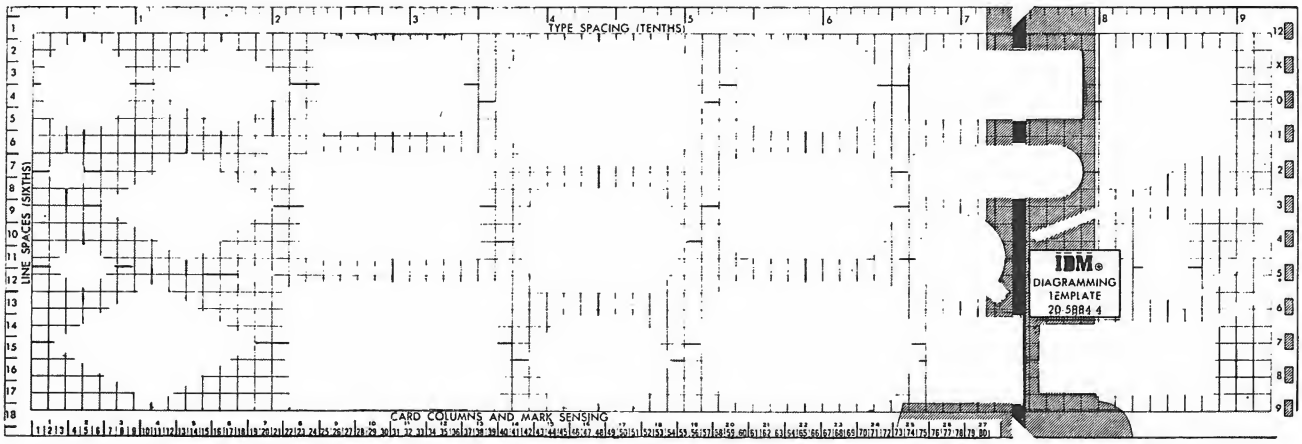

Figure 18. Flow Chart Template